Journal of Feline Medicine and Surgery (2022) **24**, 4–30

SPECIAL ARTICLE

2022 ISFM Consensus Guidelines on the Management of Acute Pain in Cats

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Practical relevance: Increases in cat ownership worldwide mean more cats are requiring veterinary care. Illness, trauma and surgery can result in acute pain, and effective management of pain is required for optimal feline welfare (ie, physical health and mental wellbeing). Validated pain assessment tools are available and pain management plans for the individual patient should incorporate pharmacological and non-pharmacological therapy. Preventive and multimodal analgesia, including local anaesthesia, are important principles of pain management, and the choice of analgesic drugs should take into account the type, severity and duration of pain, presence of comorbidities and avoidance of adverse effects. Nursing care, environmental modifications and cat friendly handling are likewise pivotal to the pain management plan, as is a team approach, involving the cat carer.

Clinical challenges: Pain has traditionally been under-recognised in cats. Pain assessment tools are not widely implemented, and signs of pain in this species may be subtle. The unique challenges of feline metabolism and comorbidities may lead to undertreatment of pain and the development of peripheral and central sensitisation. Lack of availability or experience with various analgesic drugs may compromise effective pain management.

Evidence base: These Guidelines have been created by a panel of experts and the International Society of Feline Medicine (ISFM) based on the available literature and the authors' experience. They are aimed at general practitioners to assist in the assessment, prevention and management of acute pain in feline patients, and to provide a practical guide to selection and dosing of effective analgesic agents.

Keywords: Acute; analgesia; anti-inflammatory drugs; behaviour; dental; facial expressions; pain assessment; opioid; ovariohysterectomy

Introduction

The feline population has grown significantly in recent years, with a current estimate of around 70 million pet cats in the USA and Canada.[1,2] These individuals will require veterinary care and the majority undergo at least one surgery (ie, elective neutering) during their lifetime. Others will have medical conditions or trauma requiring hospitalisation, diagnostic examinations, intravenous treatments and palliative care. Effective acute pain management is required in most, if not all, of the above scenarios and must be an integral part of feline practice. Pain has a negative impact on feline welfare. It is a basic requirement that each feline practitioner performs pain assessment during every physical examination, in addition to recording the temperature, pulse, respiration (TPR) and conducting a nutritional assessment. This requires proficient recognition and management of pain in cats, aspects of which are species-specific.

ISFM welcomes endorsement of these Guidelines by the American Association of Feline Practitioners (AAFP).

Our knowledge of feline pain management has progressed over recent years. Review articles have been published on different aspects of pain management in cats.[3–6] Moreover, there are now three scales with reported validity for acute feline pain assessment that take into consideration facial expressions and the cat's unique behaviour.[7–10] All three provide clinical guidance on the need for analgesia when a cut-off value is reached. However, rescue interventions may be administered even when the cut-off is not reached if the veterinarian feels that the cat could be in pain. The advent of valid pain assessment systems has improved our ability to recognise and assess pain in the clinical setting. It has also led to more robust research and clinical studies, and provided more objective outcome measures for approval of feline-specific drugs.

DOI: 10.1177/1098612X211066268

Figure 1 **Feline friendly handling techniques should be used for every interaction with cats. This will ensure optimal healthcare by reducing the cat's stress, improving personnel safety and providing a positive outcome for the patient, client and veterinary team. After observation of the cat's normal behaviour, the patient is calmly approached and stroked, and the painful area is gently palpated.**
Image courtesy of Paulo Steagall

Figure 2 **The hospital environment has an influence on the patient's pain experience. A cat ward should be a quiet and comfortable area, considering the specific needs of this species. A hospital cage equipped with a cardboard box provides an elevated area where the cat can perch ('a safe place'). Simple enrichment measures, such as this, can improve the hospital experience and reduce stress.**
Image courtesy of Paulo Steagall

We no longer rely on extrapolation of scientific information from dogs for analgesic techniques and dosage regimens in cats. The published literature contains several feline-specific pharmacokinetic–pharmacodynamic studies involving analgesics. Opioids and non-steroidal anti-inflammatory drugs (NSAIDs) with market authorisation specifically for cats are now available to the feline practitioner, and cat owners have come to expect safe and effective pain relief for their pets.[11,12] Historically, however, feline pain management was neglected.[13] Thankfully this attitude has changed and advancements continue to be made,[14] but there are still areas for improvement. For example, pain assessment is not commonly performed in the clinical setting and validated pain assessment tools are not widely implemented in small animal practice.[15] Many veterinarians do not administer or prescribe analgesics to cats after discharge and following routine procedures (eg, neutering).[16]

Here, the International Society of Feline Medicine (ISFM) provides its first guidelines on acute pain management using current evidence-based information and expert consensus. The Guidelines identify areas where critical research is needed and emphasise pain management as a key component of feline welfare. Throughout, the utility of a multimodal and preventive analgesic approach is highlighted, involving non-pharmacological and pharmacological therapy, cat friendly handling techniques, and respect and empathy for feline patients.

Cats are unique and so is their behaviour, especially when fear, anxiety and stress are present in the hospital setting.

Assessment and recognition of pain in cats

Principles of pain assessment

Cats are unique and so is their behaviour, especially when fear, anxiety and stress are present in the hospital setting. The assessment and treatment of pain is only one part of the pain management 'puzzle'; every manipulation and physical examination should be performed using cat friendly handling techniques (Figure 1).[17] Pain management is not only about giving an analgesic drug: the emotional needs of the hospitalised cat must be considered (Figure 2), and the individual itself should always be treated with respect and empathy.

Pain assessment is the first step towards appropriate treatment. Failure to recognise pain is likely the primary cause of inadequate treatment (oligoanalgesia; ie, undertreatment of acute pain).[16] Recognition of pain requires understanding of this species' reactions within a hospital setting. Signs of pain may be subtle and misinterpreted; for example, when a cat simply reduces movement and 'freezes' due to fear. However, the veterinary care team and owners, too, can be trained to improve their pain assessment skills and several websites are available for this purpose.[18–20] Used in isolation, physiological variables are not reliable in acute pain assessment, since they can be affected by disease, fear and stress.[21–23] However, appetite may be a 'pain indicator', as painful individuals generally do not eat.[24]

Overall, acute pain assessment is subjective, although subjectivity and bias can be reduced with specific guidelines and assessment tools (see later). In cats, and other animals, all assessments depend on the observations of a veterinary professional or carer and hence are termed 'observer-related outcomes'. Assessment includes, but is not limited to, observation of posture, general behaviour, comfort with interactions, activity, attitude, body position and facial expressions. In conjunction with this, a dynamic and interactive approach is recommended, usually involving greeting the cat while performing gentle palpation of the wound and/or suspected painful area. This is an important step, otherwise evoked pain may be overlooked; it should be possible to palpate around surgical wounds without a strong reaction from the cat if pain is well controlled (Figure 3).

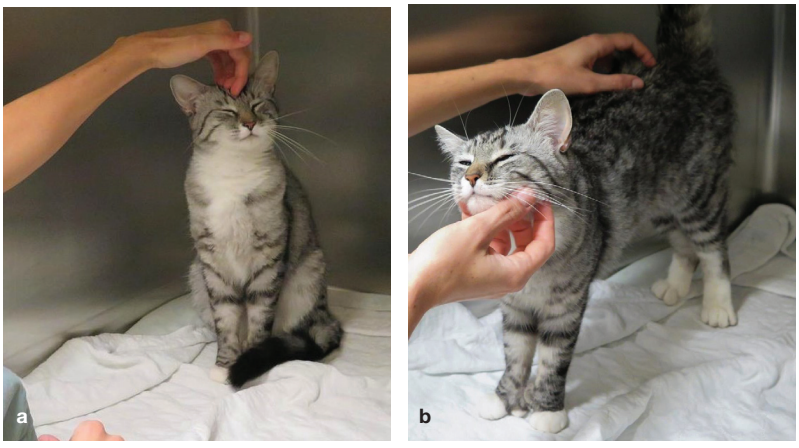

Figure 3 **Clinical pain assessment incorporates 1) observations of posture, general behaviour, comfort, activity, attitude, body position and facial expressions, and 2) a dynamic and interactive approach involving greeting the animal and performing gentle palpation of the wound/painful area. The response elicited during touch and palpation may help with clinical decisions and with determining the sensory–discriminatory domain of pain (intensity, location and duration). (a) A healthy cat is examined prior to surgery. After observing the cat's normal behaviour, the cage is opened, and the patient is gently approached and stroked. (b) The cat responds to the interaction with the observer and shows a friendly demeanour. This should be maintained after surgery if the cat is not painful.** *Images reproduced from Steagall and Monteiro (2019)*[5]

Pain-related behaviours have been described in detail in cats (Table 1), particularly in those undergoing abdominal surgery and dental extractions (Figure 4).[25,26] The development of new behaviours or loss of previous behaviours beyond the immediate postoperative period may be indicative of pain. For example, a friendly, pain-free cat normally interacts with members of the veterinary care team, tolerates gentle abdominal palpation and displays normal behaviours such as stretching, playing and yawning. The cat may sleep during hospitalisation in a 'bagel', 'croissant' or 'pretzel' curled-up position

Table 1 **Behaviours suggestive of acute pain in cats, depending on the source of pain**

Category of behaviour	Description of behaviour
Abdominal pain and various painful conditions	
Posture and activity	✣ Crouched/hunched posture ✣ Laying in dorsolateral recumbency with pelvic limbs extended or contracted ✣ Laying down being quiet ✣ Abdominal muscle (flank) contraction ✣ Vocalisation (growling, groaning, howling, hissing) ✣ Depression/dull mentation ✣ Restlessness
Interaction with the observer and the environment	✣ Lack of interest in the surroundings ✣ Withdrawing/hiding ✣ Facing the back of the cage ✣ Reluctance to move after stimulation ✣ Unwilling to play or interact with the observer ✣ Attempting to hide/escape from the observer ✣ Irritation ✣ Aggression/self-defensiveness
Other behaviours	✣ Excessive attention to the wound (licking, biting) ✣ Reaction to palpation of the wound ✣ Decreased grooming and/or appetite
Facial expressions	✣ Ears pulled apart and rotated outwards ✣ Squinted eyes ✣ Tense muzzle (elliptical shape) ✣ Straight whiskers (pointing forwards) ✣ Lowered head position (in relation to shoulder line)
Postoperative pain (eg, following dental extractions)	
General behaviours	✣ Decreased activity ✣ Reluctance to move ✣ Decreased playfulness ✣ Difficulty prehending dry food ✣ Head shaking

Adapted from Steagall (2020)[27]

Many veterinarians do not administer or prescribe analgesics to cats after discharge and following routine procedures (eg, neutering).

Pain-related behaviours in cats

Figure 4 (a) A cat with abdominal pain following ovariohysterectomy. The cat is depressed, immobile and silent. The patient has squinted eyes and is in a hunched-up position with head down. (b) A cat with abdominal pain secondary to constipation. The eyes are partially closed ('feigned sleep'), the ears are pulled apart (ie, distance between the tips of the ears is increased when compared with a non-painful cat), and the muzzle is retracted backwards (whiskers are straight, not loose and curved). (c) Periodontal disease, such as gingivitis and periodontitis, causes pain, inflammation, dysphagia, chronic haemorrhage and weight loss. Painful cats with severe oral disease (eg, requiring multiple dental extractions) have decreased food intake, increased pain scores and present distinct behaviours such as reduced attention to surroundings and spending more time lying down, compared with pain-free cats with minimal periodontal disease. Following dental extractions, this cat scores 9/10 using the Feline Grimace Scale and requires the administration of opioids for pain relief. (d) A cat with abdominal pain can contract or extend its pelvic limbs and/or contracts its abdominal muscles (flank) spontaneously. These cats may be in dorsolateral recumbency with facial expressions of pain. (e) A tense and depressed cat in severe pain after sternotomy. This patient is sitting up due to intense discomfort, reluctant to move and not attentive to the surroundings. The cat received a score of 8/10 using the Feline Grimace Scale, indicating the need for analgesia. The cat remained uncomfortable and bothered by all bandages, catheters and nursing needs, despite infusions of opioids, ketamine and lidocaine, and the administration of NSAIDs and intercostal nerve blocks. This demonstrates that pain can be challenging to treat in some cases. The cat finally improved and analgesic infusions were tapered down before patient discharge. *Images (a), (c), (d) and (e) courtesy of Paulo Steagall. Image (b) reproduced from Steagall and Monteiro (2019)*[5]

'Feigned sleep' can be observed in painful states and might be erroneously interpreted by owners and professionals unaware of pain behaviours as a 'resting cat'.

(Figure 5). These individuals usually have an interest in their surroundings and respond to stroking. Eating and grooming are normal behaviours that should be present in the postoperative period in comfortable cats. When a cat is painful, these behaviours may quickly disappear. It is important to note that the entire veterinary care team should be trained, and actively involved, in feline pain assessment.

Pain assessment is best performed on a regular basis. However, the cat should not be disturbed while it is eating, grooming, playing and/or sleeping. The frequency of assessment

Figure 5 The curled-up position of this pain-free cat is a normal posture to conserve body heat and is not usually observed in painful cats. *Image reproduced from Steagall and Monteiro (2019)*[5]

should be determined based on the pain severity noted on the first assessment after surgery or trauma, the cat's response to analgesic administration or non-pharmacological intervention and clinical judgement. Cats may be evaluated as soon as 30–45 mins after the end of surgery and then every hour in the initial postoperative period, depending on the analgesic drugs and techniques used. Assessment should be continued to ensure comfort and until the patient is discharged.[26] After discharge, assessment can continue at home with cat carers trained to look for signs of pain.

A detailed review of feline acute pain assessment is available elsewhere.[5]

Frequency of pain assessment

Patient status, type of surgery or medical condition, pain severity, hospitalisation, individual responses to analgesia, age, temperament, illness and residual anaesthetic effects will all dictate the frequency of pain assessment.

Table 2 Overview of feline acute pain assessment tools

	UNESP-Botucatu multidimensional feline pain assessment scale short form (UFEPS-SF)	Glasgow composite measure pain scale-feline (Glasgow CMPS-Feline)	Feline Grimace Scale
Components	✣ Posture ✣ Comfort ✣ Activity ✣ Attitude ✣ Reaction to touching and palpation	✣ Vocalisation ✣ Posture and activity ✣ Attention to wound ✣ Ear position ✣ Shape of muzzle ✣ Response to interaction with the observer ✣ Palpation of painful area ✣ Qualitative behaviour	'Action units': ✣ Ear position ✣ Orbital tightening ✣ Muzzle tension ✣ Whisker position ✣ Head position
How to use the tool	There are four questions (0–3). The sum of the scores for each question is the final score for that cat (total of 12 points). Evaluation starts with observation of the undisturbed cat. Then the cat is approached for evaluation of the remaining items	Each item is scored (scores vary from item to item). The sum of the scores for all eight items is the final score for that cat. Evaluation starts with observation of the undisturbed cat, including its facial expressions. Then the cat is approached for evaluation of the remaining items	Each action unit is rated from 0 to 2, where 0 = action unit is absent; 1 = moderate appearance of the action unit, or uncertainty over its presence or absence; and 2 = obvious appearance of the action unit. Non-visible action units are not scored. The final score is the sum of scores divided by the number of scored action units
Validation of tool	Comprehensive validity, reliability, sensitivity and sensibility in cats with postoperative pain following ovariohysterectomy	Evidence of construct validity and responsiveness in cats with a variety of painful conditions	Shown to be valid and reliable in cats with varied painful conditions in both real-time and image assessment, and in cats before and after dental extractions. The tool is not affected by the presence of a caregiver nor by the administration of acepromazine–buprenorphine. Inter-observer reliability has been reported for cat owners, veterinary nurses, and students and veterinarians
Intervention score*	⩾4/12	⩾5/20	⩾0.4/1.0
Comments	Can be used for both medical and surgical pain with reported validity. The short-form instrument overcomes the limitations of the previous long form	Easy and quick to use	Reported high discriminative ability, good overall inter-observer reliability, excellent intra-rater reliability and excellent internal consistency. Easy and quick to use
Source	Video-based training on feline acute pain and use of the scale is available in the Animal Pain website	newmetrica.com/acute-pain-measurement/download-pain-questionnaire-for-cats	felinegrimacescale.com

Adapted from Steagall (2020)[27]
*'Cut-off' value at which point administration of analgesia is required; note a veterinarian may administer rescue intervention when the cut-off is not reached if it is considered that the cat may be in pain
UNESP = Universidade Estadual Paulista; UFEPS = UNESP Feline Pain Scale

Table 3 UNESP-Botucatu multidimensional feline pain assessment scale short form (UFEPS-SF)

Item	Description	Score
Evaluate the cat's posture in the cage for 2 mins		
1	Natural, relaxed and/or moves normally	0
	Natural but tense, does not move or moves little or is reluctant to move	1
	Hunched position and/or dorsolateral recumbency	2
	Frequently changes position or restless	3
2	The cat contracts or extends its pelvic limbs and/or contracts its abdominal muscles (flank)*	☐
	The cat's eyes are partially closed (do not consider this item, if present, until 1 h after the end of anaesthesia)*	☐
	The cat licks and/or bites the surgical wound*	☐
	The cat moves its tail strongly*	☐
	All of the above behaviours are absent	0
	Presence of one of the above behaviours	1
	Presence of two of the above behaviours	2
	Presence of three or all of the above behaviours	3
Evaluation of comfort, activity and attitude after the cage is open and how attentive the cat is to the observer and/or surroundings		
3	Comfortable and attentive	0
	Quiet and slightly attentive	1
	Quiet and not attentive. The cat may face the back of the cage	2
	Uncomfortable, restless and slightly attentive or not attentive. The cat may face the back of the cage	3
Evaluation of the cat's reaction when touching, followed by pressuring around the painful site		
4	Does not react	0
	Does not react when the painful site is touched, but does react when it is gently pressed	1
	Reacts when the painful site is touched and when pressed	2
	Does not allow touch or palpation	3

From Belli et al (2021)[9]
*Tick where applicable
UNESP = Universidade Estadual Paulista; UFEPS = UNESP FEline Pain Scale

Pain assessment tools

The use of pain assessment tools allows a consistent, practical and more objective approach to pain evaluation. In a busy clinical setting when several team members participate in pain assessment, use of a structured tool reduces inter-observer variability.

There are now three user-friendly pain assessment tools with reported validity in cats (Table 2): the Glasgow composite measure pain scale-feline,[7] the UNESP-Botucatu multidimensional feline pain assessment scale short form (Table 3) and the Feline Grimace Scale.[7–9,24,28–32] The challenges facing us are how to disseminate this information, how best to incorporate these tools/systems into practice and how to train the veterinary clinic team. Facial expressions are incorporated into all three of these acute pain assessment tools; the Feline Grimace Scale (felinegrimacescale.com) is based entirely on facial 'action units' (Figure 6).[8,29,30,33] These scales provide a cut-off/intervention score that suggests administration of analgesia is required (Table 2). Guidance to assist the veterinary nurse or technician in advocating for their patient, and the clinician with decision-making, is a clear benefit of using pain assessment tools. If the cat receives rescue intervention(s), pain assessment is repeated after 30–45 mins to ensure that treatment has been effective.

Limitations and factors affecting pain assessment/recognition

The advent of novel pain assessment systems has improved our ability to recognise and treat pain in cats. However, these instruments have not fully eliminated potential confounding factors and bias. Temperament (fearful, shy, etc), the administration of some drugs (eg, sedatives

The use of pain assessment tools allows a consistent, practical and more objective approach to pain assessment.

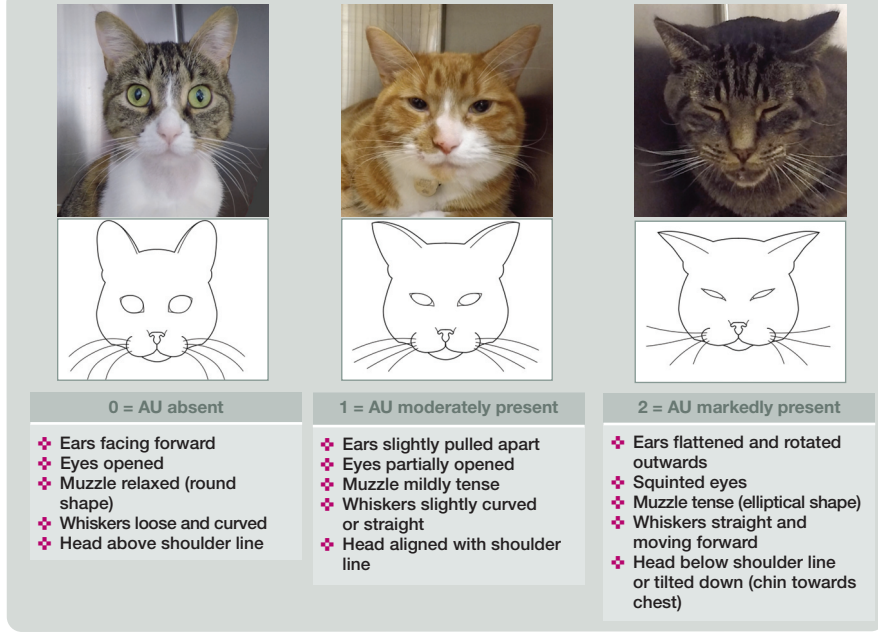

Figure 6 Illustration and description of the Feline Grimace Scale. This pain assessment tool is composed of five action units (AU) (ear position, orbital tightening, muzzle tension, whisker position and head position). Each one is scored from 0 to 2: 0 = action unit is absent; 1 = moderate appearance of the action unit, or uncertainty over its presence or absence; and 2 = obvious appearance of the action unit. *Adapted from Evangelista et al (2020)*[29]

Figure 7 **(a,b) Means of pain assessment can be limited in trap–neuter–return programmes or when working with other unsocialised cats. However, cats may still be evaluated using the Feline Grimace Scale, with observation of posture, comfort and facial expressions. Treatment of pain should be performed using a multimodal approach, based on the observer's interpretation of how painful the cat's condition could be, since wound palpation, for example, may not be possible. As with all patients, these individuals should be handled with empathy and care.** *Images courtesy of Sheilah Robertson*

or tranquillisers) and illness can still pose challenges during pain assessment.[34–37] Fear and anxiety may bias pain assessment due to changes in posture, comfort and facial expressions.[38] For example, pain assessment can be a challenge in unsocialised cats in trap–neuter–return programmes (Figure 7). The administration of ketamine-based protocols produces a confounding effect early in the recovery period and may falsely increase pain scores, which could lead to unnecessary administration of rescue analgesia.[39] Residual anaesthetic and drug effects may also bias pain assessment. Pain may be difficult to differentiate from drug-induced dysphoria (see box).

Pain scores may be influenced by the gender, training, cultural background and language of the observer, demonstrating that pain assessment is not an exact science and differences may be expected.[34–36] It has been found that females and those with more training will provide higher pain scores than males and those with minimal training.[13,34,36] Feline pain assessment should be integrated into the veterinary curriculum in conjunction with cat friendly handling techniques.

Cat carers should be considered part of the 'team' when it comes to pain management. Client education regarding pain behaviours (what to expect and how to proceed) is important and could lead to early intervention by prompting the client to seek veterinary attention.[5] For example, cat owners can identify specific behavioural alterations up to 3 days after castration or ovariohysterectomy.[42] A decrease in overall activity level and playfulness, an increase in the amount of time spent sleeping, and altered locomotion were reported by these owners.[42] ISFM has produced a Cat Carer Guide to acute pain in cats (see page 30). Finally, the Feline Grimace Scale can be used reliably by cat owners, veterinary nurses and students, providing the first feline acute pain assessment tool that may be used in the home environment[33] and by non-veterinarians, thereby paving the way towards better feline welfare.

Identifying and managing dysphoria

If pain is suspected based on surgery and/or the presence of a medical condition, the administration of analgesics such as an opioid, or NSAID (if not given within the previous 24 h), is recommended (ie, 'analgesic challenge'). If pain behaviours subside it confirms that pain was present. No changes or worsening of these behaviours could indicate dysphoria. At this time administration of a sedative is recommended. The use of opioid antagonists could also be part of treatment; however, analgesic effects may also be antagonised, and the cat could become painful if other analgesic modalities are not in place. Butorphanol has been administered as an alternative to naloxone for the reversal of opioid agonists, as it may preserve analgesia better than the latter.[40]

A 'troubleshooting dysphoria' algorithm, with recommended treatment steps for dealing with a dysphoric cat, is available in the supplementary material (see page 24), reproduced from the AAFP Feline Anesthesia Guidelines published in 2018.[41]

Figure 8 **Persistent postoperative pain in a 7-year-old female cat after onychectomy. The cat persistently keeps the left paw lifted while sitting, to avoid bearing weight on it, and also resents being touched on that paw.** *Image reproduced from Monteiro BP and Steagall PV. Chronic pain in cats: recent advances in clinical assessment. Journal of Feline Medicine and Surgery 2019; 21: 601–614*

Treatment of pain – principles and considerations

Failure to recognise and adequately treat acute pain is known as oligoanalgesia. The lack of analgesic administration to a painful cat may lead to the development of peripheral and central sensitisation,[16,43] which in turn can reduce the nociceptive threshold to non-noxious and noxious stimuli (Table 4).[44] In humans, inadequate treatment of pain following surgical procedures including, but not limited to, amputation, thoracotomy, mastectomy[45] and caesarean section[46] can result in a transition to chronic or maladaptive pain states (ie, persistent postoperative pain), leading to disability and a negative impact on quality of life. A similar scenario may occur in cats;[43] for example, after onychectomy (Figure 8).

Table 4 Glossary of terms used in the neurophysiology of pain

Term	Explanation
Peripheral sensitisation	Reduced pain thresholds that occur following tissue damage, which are caused by an increase in the concentration of chemical mediators in the damaged tissue. There are many mediators of peripheral sensitisation and as a group they are called eicosanoids
Central sensitisation	Reduced pain thresholds that occur following tissue damage, which are caused by altered sensitivity of the nociceptive pathways because of repeated stimulation. The main sites of central sensitisation are the dorsal horn of the spinal cord and the higher centres of the brain, especially the cerebral cortex
Hyperalgesia	Increased pain due to stimulation of damaged tissue by a stimulus that would normally be perceived as painful. The stimulation is felt as more painful than it would be if the tissues were not damaged. Hyperalgesia is a clinical sign of peripheral and central sensitisation
Allodynia	Pain due to stimulation of damaged tissue by a stimulus that would *not* normally be perceived as painful. The stimulation is felt as painful because the tissues are damaged. Allodynia is a clinical sign of peripheral and central sensitisation
Persistent postoperative pain	Pain perceived following surgery that lasts longer than it usually would. Persistent postoperative pain is a common consequence of poor or absent pain relief at the time of surgery

Adapted from Steagall et al (2021)[44]

Understanding the principles of acute pain management aids in the development of an effective analgesic strategy and can mitigate or prevent oligoanalgesia and adverse outcomes in cats, a species in which analgesic administration has historically been neglected.

Feline drug metabolism and elimination: impact on analgesia

Drug metabolism and elimination are different in cats compared with other species. This has a significant influence on drug choice, dose and dosing intervals of analgesics. Drugs that are eliminated by metabolic conjugation (ie, glucuronidation, sulfation and/or glycosylation) are usually excreted more slowly in cats than in humans or dogs.[47] Examples include acetylsalicylic acid, acetaminophen (paracetamol), carprofen, ketoprofen and morphine. Deficient glucuronidation has significant effects on phenolic compounds such as acetaminophen, resulting in life-threatening methaemoglobinaemia due to oxidative injury to erythrocytes, anaemia and Heinz body formation.[47,48] The clearance of carprofen is significantly slower in cats than in dogs (ie, the drug has a much longer elimination half-life in cats).[49] The deficient UDP-glucuronosyltransferase (UGT) pathways in cats may also be responsible for reduced morphine glucuronidation in cats. Cats eliminate morphine at a similar rate to dogs; however, they produce lower concentrations of morphine-3-glucuronide, and do not produce morphine-6-glucuronide, an active metabolite responsible for analgesia in humans.[50]

Drugs that undergo metabolic conjugation are usually eliminated more slowly in cats compared with dogs, while those that undergo oxidation are often eliminated more rapidly.

Conversely, drugs that primarily undergo oxidation are often eliminated more rapidly in cats compared with dogs. Examples include meloxicam, piroxicam, buprenorphine and meperidine (pethidine). The major route of elimination of meloxicam in cats is via the gut (faeces), which is similar to dogs; the main pathway of meloxicam biotransformation is oxidation.[51,52]

Drugs that are excreted unchanged into urine and/or bile such as gabapentin have similar elimination half-lives in dogs and cats.[47]

Feline comorbidities

The presence of comorbidities must be considered in the treatment of pain. As many as 40% of cats over 10 years of age have chronic kidney disease (CKD).[53] Drugs or metabolites that require healthy kidney function for excretion may accumulate in cats with CKD. Therefore, doses and dosing intervals may require adjustment and this will be based on clinical experience, the patient's response and pain assessment. The effects of drugs may not be predictable because, in addition to decreased renal elimination in the face of CKD, azotaemia increases blood–brain barrier permeability, which can result in a more enhanced drug effect. A classic example is the metabolism of ketamine by the liver into the active metabolite norketamine, which is excreted by the kidneys in its active form along with ketamine itself. Ketamine and norketamine accumulation may occur, with potential prolonged anaesthetic effects in cats with urethral obstruction or kidney dysfunction. Metabolic acidosis in cats with CKD can alter the biodisposition of ketamine, resulting in accumulation. Outcomes may depend on dose since accumulation does not appear to be a problem with the administration of subanaesthetic (anti-hyperalgesic) doses of ketamine given by infusion (10 µg/kg/min) as a component of a postoperative analgesic regimen after feline subcutaneous urethral bypass when renal function is improving.[27]

Overall, best practice with respect to anaesthesia and analgesia is particularly important in cats with comorbidities. The administration of fluid therapy will correct dehydration and electrolyte and acid–base abnormalities while maintaining adequate renal blood flow during anaesthesia and supporting drug excretion. In some cases, the administration of a minimum effective dose of an NSAID can be considered for normovolaemic cats with stable renal disease (International Renal Interest Society [IRIS] stage I or II) undergoing

Principles of acute pain management

Preventive analgesia

Preventive analgesia refers to all types of perioperative techniques and efforts to decrease postoperative pain. Analgesic treatment is administered at any time and for any duration needed for pain relief in the perioperative period. (Note that 'pre-emptive' analgesia refers to the administration of analgesics prior to surgery.)

Multimodal analgesia

Multimodal analgesia is the administration of two or more analgesic drugs with different mechanisms of action. These drug combinations may have a synergistic effect, allowing use of lower doses for each class and consequently preventing treatment-induced adverse drug reactions.[55,56] Multimodal analgesia may also include non-pharmacological techniques such as application of cooling/cold therapy.

surgery with a strong inflammatory component (eg, multiple dental extractions, fracture repair, large excisions) once blood pressure is controlled and there is no risk of intraoperative haemorrhage. Ideally, the cat should be eating and drinking after anaesthetic recovery before the administration of an NSAID.[54]

Building an analgesic plan

Building an effective analgesic plan relies on two fundamental principles: preventive analgesia and multimodal analgesia (see box above).

The first step of acute pain treatment involves the administration of opioids, local anaesthetics and NSAIDs. The second step of treatment involves the administration of adjuvant analgesics.[57] Further therapy should focus on analgesia and comfort, while minimising adverse drug reactions and preventing deleterious endocrine and physiological responses. Additional steps of equal importance include anxiolysis and muscle relaxation, antiemetics and non-pharmacological therapy, which should be incorporated when needed (Figure 9). Maropitant and ondansetron reduce perioperative vomiting in cats,[58,59] and gabapentin or trazodone are often administered to reduce anxiety; for example,

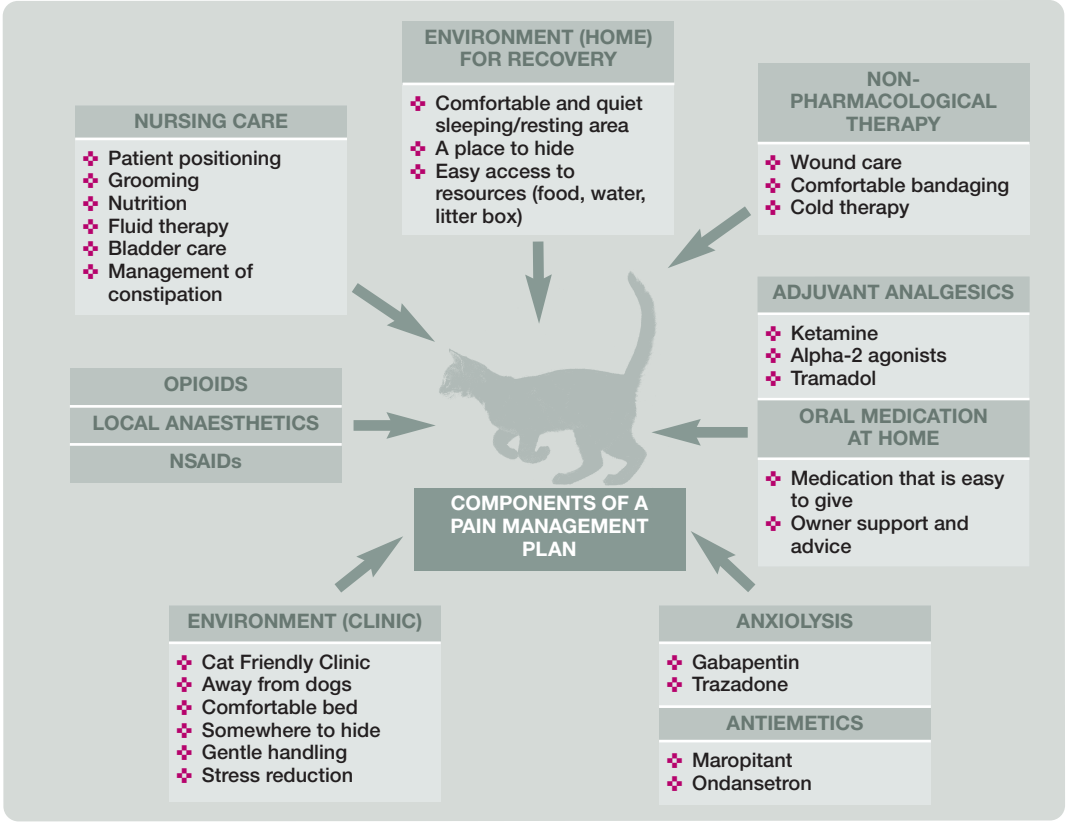

Figure 9 Successful management of acute pain does not just include use of analgesic agents – a combination of components is fundamental to a successful pain management plan

Pain management is not only about giving an analgesic drug: the emotional needs of the cat must be considered, and the patient should always be treated with respect and empathy.

during hospitalisation.[60,61] Non-pharmacological therapies should be incorporated when possible and include appropriate bandaging (wound care), cold therapy[62] (Figure 10), nursing (ie, patient positioning, fluid therapy, nutrition, cleaning and grooming), environment (ie, dry, calm, quiet and comfortable) (see Figure 2) and an area for cats that is separated from dogs (eg, as included in the requirements for ISFM Cat Friendly Clinic accreditation and the AAFP Cat Friendly Practice Program).[17,63]

Figure 10 **A cat undergoing ice therapy after total ear canal ablation. Cold therapy is an example of a non-pharmacological tool that provides effective analgesia, and is readily available.** *Image courtesy of Paulo Steagall*

Treatment will be determined by the type, location, severity and expected duration of stimuli, and whether the cat is an inpatient or outpatient. The analgesic plan will be based on these key concepts, which can be referred to using the acronym 'TELLS' (Table 5 and Figure 11). For example, acute visceral pain associated with elective procedures (eg, feline neutering) may be treated effectively with NSAIDs, opioids, alpha-2 agonists[64,65] and local anaesthetic techniques (eg, intratesticular, incisional, intraperitoneal or transversus abdominis plane [TAP] block). Acute somatic or neuropathic pain associated with orthopaedic or vertebral surgery/spinal cord injury may require the addition of N-methyl D-aspartate (NMDA) receptor

Table 5 **Key concepts (TELLS) used for pain management,* with specific examples**

	Examples	Comments
Type of noxious stimuli	Visceral, neuropathic, somatic, orofacial, oncologic	Certain analgesic drugs may be more effective for certain types of pain. For example, analgesic drugs that help treat peripheral or central sensitisation (eg, ketamine or methadone) may be an appropriate choice in cases of neuropathic injury
Expected duration of noxious stimuli	Transient stimuli of <2 h (placement of a urinary catheter or endoscopy) vs prolonged and sustained (24–72 h) stimuli, following surgery	This should affect frequency and need for pain assessment. Analgesic drug may be determined based on duration of action. Hospitalisation and analgesic infusions may be required
Location of noxious stimuli	Thoracic limb, pelvic limb, orofacial, abdominal, intrathoracic	Useful when considering locoregional techniques
Location of patient during treatment	Outpatient or inpatient	This may influence the route and frequency of analgesic administration (dosage regimens). Also the frequency of pain assessment
Severity of noxious stimuli	Mild, moderate or severe	May affect the dose and choice of analgesic drug class

*These concepts help determine the dose, frequency, type and route of analgesic drug(s) to be provided

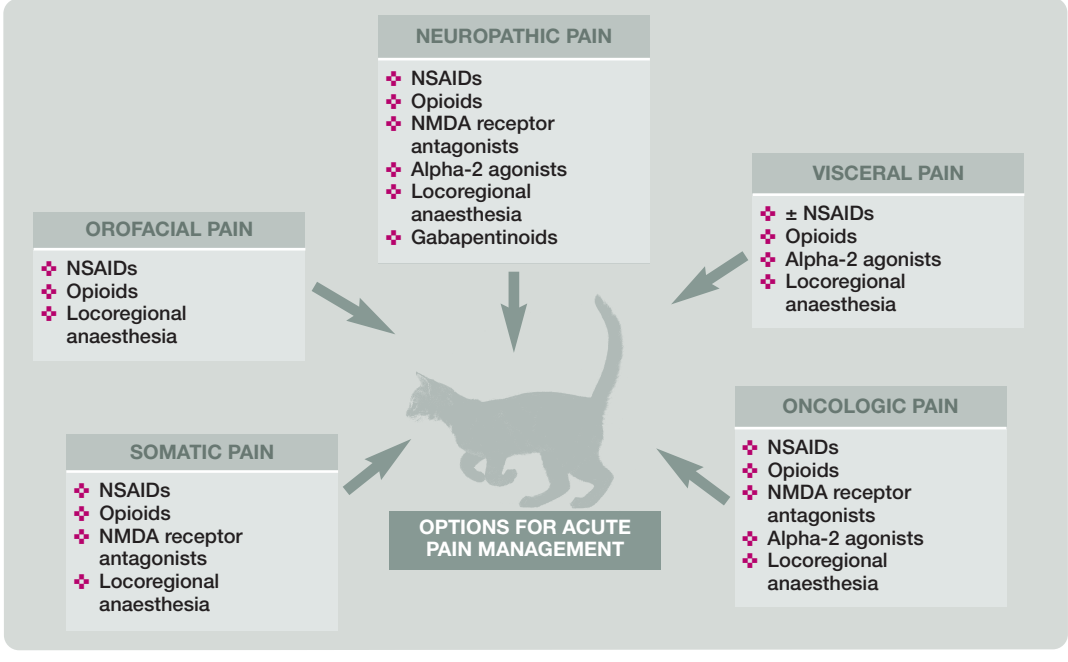

Figure 11 **Suggestions for acute pain management in patients with specific types of pain. NSAID = non-steroidal anti-inflammatory drug; NMDA = N-methyl D-aspartate**

Building an analgesic plan: practical considerations

✣ **Type of local anaesthetic block that can be used for a specific procedure** For example, locoregional anaesthetic techniques are effective and can be used to manage pelvic limb (sciatic and femoral nerve block or lumbosacral epidural), thoracic limb (brachial plexus or radial [R], ulnar [U], median [M], musculocutaneous [M] [RUMM] nerve block), abdominal (TAP block, intraperitoneal analgesia), dental (dental nerve blocks) and thoracic (intercostal nerve block) pain (see later discussion of 'Local anaesthetics'). Most of these techniques are not described in detail in these Guidelines, but are reviewed elsewhere.[67,68]

✣ **Opioid of preference, depending on the type of surgery/painful condition** For example, full agonists of μ-opioid receptors (eg, methadone, fentanyl) provide dose-dependent analgesia and are preferred for moderate to severe pain. Buprenorphine (a partial μ-opioid agonist) can be used for mild to moderate pain as part of a multimodal analgesia protocol. Butorphanol and nalbuphine (agonist–antagonist opioids) provide limited analgesia (see below discussion of 'Opioids').

✣ **Potential for use of NSAIDs** If there are no contraindications for the administration of NSAIDs (eg, meloxicam, ketoprofen, robenacoxib), these drugs are excellent analgesics and should be included in the analgesia strategy for almost all forms of acute perioperative pain because surgery results in inflammation.

✣ **Requirement for adjuvant analgesics** Adjuvant analgesics (ketamine, gabapentinoids, tramadol, etc) are administered for the treatment of severe acute pain and prevention of persistent postoperative pain, especially if NSAIDs are contraindicated.

✣ **Duration of acute perioperative pain** Acute perioperative pain often lasts beyond the duration of the cat's hospital stay and routinely requires transitioning from parenteral to oral or transmucosal/buccal analgesics.

antagonists (eg, ketamine, amantadine) and gabapentinoids.

The expected duration and severity of pain also determines which analgesic drugs are best suited for each individual patient. In cats with prolonged moderate to severe pain, pain management can be performed with intermittent doses of buprenorphine[66] or methadone. Alternatives include constant rate infusions (CRIs) of opioids and/or ketamine. Specific classes of analgesics are discussed below.

The inpatient or outpatient nature of the treatment may affect the frequency and route of administration. Hospitals without after-hours or overnight staffing that either discharge patients or leave them unattended overnight may rely on long-lasting oral, sustained-release or transdermal analgesic drugs. However, some patients may require intense postoperative monitoring and analgesia, and should be transferred, if possible, to clinics that can provide such care (eg, CRIs of analgesics, fluid therapy, wound care and monitoring).

Therapy should focus on analgesia and comfort, while minimising adverse drug reactions and preventing deleterious endocrine and physiological responses.

Further practical considerations when building an analgesic plan in cats are outlined in the box above.

Treatment of pain – analgesic drugs

Opioids

Opioids are commonly used analgesics for acute pain in cats.[14,69] By binding to opioid receptors located within the peripheral and central nervous system they decrease the release of excitatory neurotransmitters, hyperpolarise the neuronal post-synaptic cell membrane,[70–73] inhibit Ca^{2+} influx in afferent sensory neurons, and activate the descending inhibitory pathways. The net result is an antinociceptive effect, thus producing analgesia.

Cats and opioids: myths and misconceptions

At high doses, opioids evoke a sympathetic response in cats that is mediated by autonomic centres in the brain, spinal cord and adrenal glands.[81] This produces mydriasis and increases in blood pressure and heart rate (which may be observed with high doses during surgery and confused with nociceptive stimulation), as well as adrenal vein hormone levels (ie, noradrenaline, adrenaline, dopamine and met-enkephalin[81]).

When administered at clinically relevant doses, especially as part of a multimodal plan, opioids provide excellent analgesia in cats, with few side effects.

Behavioural changes (eg, fear, anxiety, vocalisation, dysphoria) can be observed when unnecessarily high doses of opioids are given in the conscious cat and were the basis for the term 'morphine mania'. However, multiple research and clinical studies have shown that, when administered at clinically relevant doses, especially as part of a multimodal plan, opioids provide excellent analgesia in cats, with few side effects.[82–87]

The popularity of opioids is attributable to a remarkable safety profile, potential reversibility and analgesic efficacy. Opioids can be given by a variety of routes and can reduce the minimum alveolar concentration (MAC) of volatile anaesthetics, potentially improving cardiopulmonary function during general anaesthesia.[74] However, their ability to reduce MAC in cats when administered parenterally[75,76] or epidurally is lower than in dogs. For example, high doses of remifentanil reduce isoflurane requirements by a maximum of 25% in cats,[77,78] compared with 79% in dogs.[79] In cats, additional anaesthetic sparing can be achieved with the inclusion of ketamine infusions.[80]

Table 6 Commonly used opioid analgesics in cats, with suggested doses and routes of administration* (continued on page 16)

Degree of acute pain management (examples)	Drug	Dose (mg/kg or µg/kg where indicated) and potential routes of administration	Duration of analgesia	Comments
Pure µ-opioid receptor agonist				
Moderate to severe pain (orthopaedic surgery, abdominal exploratory, cystotomy, ovariohysterectomy, neuropathic pain, thoracotomy, large or multiple mass removal[s], pancreatitis, and those listed below for other classes of opioid)	Morphine	✣ 0.1–0.2 IV, IM or epidural	✣ Up to 6 h for IV or IM ✣ Up to 12–24 h for epidural	Caution with histamine release when administered IV. Administer slowly IV. Vomiting and nausea commonly occur, particularly with IM or SC route. Urinary retention may be observed following epidural administration
	Hydromorphone	✣ 0.025–0.1 IV or IM	✣ Up to 6 h for IV or IM	Vomiting and nausea commonly occur, particularly with IM or SC route. Opioid-induced hyperthermia occurs more frequently with the use of high doses of hydromorphone, either alone or in combination with other anaesthetic drugs. Increases in temperature are generally mild to moderate and are self-limiting (<4 h)
	Meperidine (pethidine)	✣ 5–10 IM	✣ 1–2 h	Should not be administered IV due to histamine release with potential skin reactions and hypotension. Duration of analgesia is short-lived and dose-dependent. Licensed for IM injection in European countries, including the UK
	Methadone	✣ 0.2–0.6 IV, IM or OTM	✣ Up to 6 h	Has NMDA receptor antagonistic effect, which may be helpful to treat peripheral and central sensitisation. Minimal vomiting and nausea when compared with hydromorphone and morphine administration. Higher doses are used for OTM administration, whereas lower doses are given IV. Licensed for use in cats in the UK, Canada, Italy and some other European countries
	Fentanyl	✣ 5 µg/kg bolus followed by infusion from 3–20 µg/kg/h IV ✣ 25 µg/h transdermal patch	✣ Provides analgesia for the duration of the infusion only ✣ Up to 72 h	Low doses are used for analgesia, whereas high doses may also provide some (15–20%) anaesthetic-sparing effect with potential simultaneous sympathetic activation. Plasma concentrations are highly variable with use of transdermal patches (human formulations) of fentanyl in cats. Analgesia is variable and may be suboptimal. Apply fentanyl patch 18–24 h prior to noxious stimuli
	Remifentanil	✣ 6–40 µg/kg/h IV	✣ Provides analgesia for the duration of the infusion only	Low doses are used for analgesia, whereas high doses may also provide some (15–20%) anaesthetic-sparing effect with potential simultaneous sympathetic activation. Loading doses of remifentanil are not required if started 15 mins prior to surgical stimulation. May contribute to opioid-induced hyperalgesia; however, this has not been confirmed in cats. Does not require hepatic metabolism; undergoes degradation via non-specific plasma and tissue cholinesterase

At effective opioid doses, mydriasis, purring, kneading and euphoria will occur (see box on page 14).

Table 6 presents suggested dosage regimens for commonly used opioid analgesics, with comments on their clinical relevance, advantages and disadvantages. Choosing an opioid analgesic is dependent on the patient's signalment, temperament, comorbidities, degree of pain intensity and required sedation level, and is also determined by the planned procedure, the pharmacology of the opioid itself (onset, magnitude and duration of action) and what the clinician has access to in their location. Kittens and young cats may require more frequent opioid dosing. One study showed that age can influence thermal antinociception produced by opioids in cats.[88] Specifically, hydromorphone provided a shorter duration and smaller magnitude of antinociception in cats of 6 months of age than in the same individuals at 9 and 12 months of age.[88]

Table 6 Commonly used opioid analgesics in cats, with suggested doses and routes of administration* (continued from page 15)

Degree of acute pain management (examples)	Drug	Dose (mg/kg or µg/kg where indicated) and potential routes of administration	Duration of analgesia	Comments
Partial µ-opioid receptor agonist				
Mild to moderate pain (castration, ovariohysterectomy, small mass removal, osteoarthritis, endoscopy, urinary catheterisation, and those listed below for agonist–antagonist opioids)	**Buprenorphine – standard formulation** (0.3 mg/ml)	✣ 0.02–0.04 IV, IM or OTM	✣ Up to 8 h	SC administration using the standard formulation is not recommended. There is no histamine release, vomiting or nausea after the administration of buprenorphine. Possible OTM administration for 'hands-off' analgesia, especially as part of multimodal analgesia. Both formulations when combined with an NSAID provide adequate analgesia for dental and neutering procedures. Not sufficient for acute pain relief following major orthopaedic procedures, especially when used as a sole analgesic. Licensed for use in cats in the UK, Canada, Australia and other countries. The high-concentration formulation is FDA-approved in the USA
	Buprenorphine – high concentration (1.8 mg/ml)	✣ 0.24 SC	✣ Up to 24 h	
Mixed µ-opioid receptor antagonist/κ-agonist				
Mild pain or to help facilitate diagnostic procedures and sedation (phlebotomy, cystocentesis, physical examination, fine-needle aspiration)	**Butorphanol**	✣ 0.2–0.4 IV or IM	✣ 1–2 h	Provides appropriate analgesia when used in a multimodal protocol for orchiectomy. Does not provide adequate analgesia when used as a sole analgesic for routine surgical procedures. Higher doses do not provide additional analgesic benefit. Large inter-patient variability in analgesia has been reported. May be a better alternative than naloxone when reversing (0.02–0.05 mg/kg IV) pure opioid receptor agonists due to its ability to preserve some antinociception
	Nalbuphine	✣ 0.15–0.3 IV or IM	✣ Not yet determined	May be a substitute for when butorphanol is unavailable. Minimal research has been performed to evaluate effectiveness for acute pain management. Dose to provide analgesia is yet to be determined
µ-opioid receptor antagonist (reversal agent)				
NA	**Naloxone**	✣ 0.01–0.04 IV diluted to 5 ml and given slowly to effect	NA	Fast administration of 0.04 mg/kg IV can produce depressed mentation and dullness (B Simon, personal observations). Administer slowly in small increments every 60 s and to effect. Analgesia will be reversed and other analgesic techniques and drugs must be considered if pain is an issue

*Doses, drugs and routes of administration presented in this table are suggestions and not exhaustive. Individual variability should be appreciated and opioids are better administered as part of multimodal analgesia. The analgesic effects may be variable depending on the type of pain, age, breed, surgical procedure, anaesthetic duration and route of administration. Clinical judgement is important. Veterinarians should consult drug labels if a veterinary product is available

NA = not applicable; IV = intravenous; IM = intramuscular; SC = subcutaneous; OTM = oral transmucosal; NSAID = non-steroidal anti-inflammatory drug; NMDA = N-methyl D-aspartate; FDA = Food and Drug Administration

Routes of administration

Traditionally, opioids are administered by the intramuscular (IM) or intravenous (IV) route. The onset, magnitude and duration of analgesia are influenced by the route of administration, which should be chosen on an individual basis.[89] The IV route provides reliable analgesia and a rapid onset of action. The subcutaneous (SC) route of administration provides less pain on injection than the IM route;[90] however, depending on the drug, dosage and formulation, large variations in the magnitude and duration of antinociception may be observed.[82–84] For example, analgesia may be suboptimal after the SC administration of recommended doses of buprenorphine or hydromorphone in cats.[84] In contrast, a high-concentration formulation of buprenorphine (1.8 mg/ml; Simbadol, Zoetis) is approved by the US Food and Drug Administration and provides up to 24 h of mild to moderate pain relief following SC administration (Table 6).[85] This formulation is also effective when given to cats by the IV or oral transmucosal (OTM) route (off-label administration), both providing up to 8 h of analgesia.[85] The OTM route is a non-invasive alternative to parenteral administration. It bypasses the first-pass effect in the liver, leading to higher bioavailability when compared with oral administration. Variations in analgesia may still occur via the OTM route, and thus the IM or IV route is preferred when possible for acute postoperative pain management.[82]

In cats, plasma drug concentrations following application of a transdermal fentanyl patch (a human product) are highly variable and may fail to produce analgesia.[91,92] A transdermal matrix patch of buprenorphine failed to produce thermal antinociception, with high plasma concentration variability of the drug, in a preliminary study of pharmacokinetics in cats.[93]

Epidural administration of opioids alone (eg, morphine or buprenorphine[94]) provides effective control of visceral[95] and somatic[96] pain, with few adverse effects[97–99] and without changes in proprioception. The bladder should be gently expressed before anaesthetic recovery to avoid the rare but reported side effect of urinary retention after the administration of epidural morphine.[96,100] Regardless of which analgesic drugs are administered, an empty bladder may improve comfort during the early recovery period.

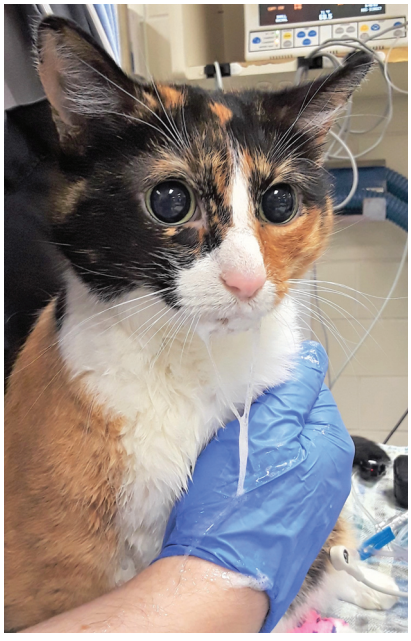

Figure 12 Mydriasis and hypersalivation in a cat following the intravenous administration of hydromorphone. *Image courtesy of Bradley Simon*

Adverse drug reactions

Some opioids may produce adverse effects, which are drug-, dose- and route-dependent (Table 6). Nausea and vomiting (Figure 12), gastroesophageal reflux, hyperthermia, dysphoria, mydriasis (Figure 12), sedation, vagally induced bradycardia, and respiratory depression with mild hypercapnia may be observed following the administration of opioids. Antiemetics (maropitant, ondansetron), prokinetics (metoclopramide), and acupuncture[101] can minimise or treat some of the adverse gastrointestinal (GI) effects associated with the administration of opioids.[102–105] These GI adverse effects can be avoided by choosing methadone, fentanyl or buprenorphine. The administration of epidural opioids provides effective long-term analgesia with few side effects.[98,99] Naloxone or butorphanol may be administered to effect when antagonising opioid-induced adverse effects. Analgesia may also be decreased or antagonised in this scenario and other analgesic techniques should be in place or considered.

Non-steroidal anti-inflammatory drugs

NSAIDs are used extensively in cats for their analgesic, anti-inflammatory and antipyretic effects, and are crucial in the control of postoperative pain. After any contraindication for their use has been ruled out (GI disease, NSAID intolerance, unmanaged renal disease, hepatic disease, coagulopathies, hypovolaemia and hypotension, concurrent NSAID or corticosteroid administration), NSAIDs are highly effective for the treatment of acute pain in cats as part of a multimodal approach.[106–114] Recommended NSAID regimens for management of acute pain in cats are summarised in Table 7.

Adverse effects (GI irritation, protein-losing enteropathy and nephrotoxicity) are reported when recommended doses or dosing intervals are not adhered to, or if NSAIDs are administered in combination with corticosteroids. Anorexia, inappetence, diarrhoea, vomiting and depression are usually the first signs of toxicity, and treatment should be stopped immediately if any of these occur. However, omitting NSAIDs because of fear of adverse effects is not recommended and may seriously compromise pain management.

Dosing should be based on lean body weight and cats should be normovolaemic

Each painful procedure a cat undergoes can have an additive effect and every opportunity should be taken to decrease pain and stress.

Table 7 Common NSAIDs used in cats for management of acute pain*

COX selectivity†	Formulation	Dose, route of administration, frequency	Dosing information	Indications and comments	Reference(s)
Meloxicam					
COX-2 preferential	Injection; 5 mg/ml	0.3 mg/kg, SC, once	Administer once only	Postoperative analgesia following OVH and minor soft tissue surgery. This is the approved dose in the USA. However, the Guidelines panel members recommend using the lower doses, as listed below	115
	Injection; 2 mg/ml	0.2 mg/kg, SC, once	Can be followed by 0.05 mg/kg PO q24h for 4 days	Mild to moderate postsurgical pain	115
	Oral suspension; 0.5 mg/ml	0.1 mg/kg, PO, day 1; then 0.05 mg/kg, PO, q24h	Can be given indefinitely	Inflammation and pain in chronic musculoskeletal conditions. These are approved doses in the EU. A minimum effective dose should be used for long-term treatment	107, 115
Robenacoxib					
COX-2 selective	Injection; 20 mg/ml	2 mg/kg, SC, q24h	Up to 3 days	Pain and inflammation associated with soft tissue surgery	109, 116
	Tablets; 6 mg	1 mg/kg, PO, q24h	Up to 6 days	Pain and inflammation associated with musculoskeletal disorders	112, 115
Ketoprofen					
None	Injection; 10 mg/ml	2 mg/kg, SC, q24h	Up to 3 days	Relief of acute pain and inflammation associated with musculoskeletal and other painful disorders	115
	Tablets; 5 mg	1 mg/kg, PO, q24h	Up to 5 days; can use injection instead on day 1	As for ketoprofen injection	115

*Veterinarians should consult drug labels in their respective countries before administering NSAIDs
†COX-2 preferential = greater suppression of COX-2 than COX-1; COX-2 selective = virtually no COX-1 suppression
COX = cyclooxygenase; OVH = ovariohysterectomy; SC = subcutaneous; PO = oral

before drug administration. Some postoperative patients may benefit from prolonged NSAID administration and this should be considered on a case-by-case basis.[115]

Meloxicam and robenacoxib have good palatability, which facilitates treatment compliance,[113,117] and once a day dosing also increases the likelihood of the cat receiving the prescribed medication. Injectable formulations are used in the perioperative period and can be administered IV (off-label use) or SC, depending on the drug used and country. Oral administration usually follows in the postoperative period and home environment. Many studies have shown that different perioperative NSAIDs usually perform similarly in terms of analgesic efficacy and duration of effect (ie, non-inferiority or comparison trials).[110,111,113]

The timing of NSAID administration is a controversial subject. NSAIDs can generally be administered preoperatively for routine neutering of healthy cats, especially if blood pressure is monitored and cats are normovolaemic. For longer procedures, fluid therapy may be indicated, blood pressure should be monitored, and the risks and benefits related to the timing of NSAID administration need to be taken into consideration.[107] The administration of NSAIDs in patients with comorbidities such as CKD was discussed in the earlier section 'Feline drug metabolism and elimination: impact on analgesia'.

Whenever possible, NSAIDS should be part of an acute pain management protocol.

Local anaesthetics

Local anaesthesia provides excellent analgesia by preventing transduction and transmission of nociceptive signals from the periphery to spinal and supraspinal centres.[118] Compared with other antinociceptive drugs, local anaesthetics are unique in providing complete analgesia. Locoregional anaesthesia is an important part of multimodal analgesia and should be incorporated into a pain management plan whenever possible. Anaesthetic maintenance and recovery are usually smooth when these techniques are integrated into the plan. Other advantages of locoregional anaesthesia include low cost, accessibility in all countries, muscle relaxation, decreases in injectable and volatile anaesthetic requirements, and, in turn, improved cardiopulmonary function.[119–122] Additionally, the effects of long-acting local anaesthetics extend into the postoperative period, and reduce the requirements for other drugs.[121,123] Recently, a liposomal bupivacaine formulation was approved for use in cats undergoing onychectomy in the USA and may provide postopera-

Table 8 Commonly used local anaesthetics for locoregional anaesthesia in cats

Local anaesthetic	Recommended maximum dose	Onset (mins)	Duration (h)*
Lidocaine	5 mg/kg	1–2	1–2
Ropivacaine	3 mg/kg	10–15	3–5
Bupivacaine	2 mg/kg	10–15	4–6
Liposomal bupivacaine	5.3 mg/kg	Not determined in cats. Several minutes in people	24–72
Local anaesthetic cream (eutectic mixture of lidocaine 2.5% and prilocaine 2.5%)	1 ml or 1 g applied to intact skin	30–60 (20 mins were enough to abolish response in dexmedetomidine–opioid-sedated cats[126])	Not determined in cats. Several hours in people

The information in this table represents a consensus of opinion of the Guidelines panel members
*The duration of a block may vary depending on the block, technique, site of injection, anaesthetic concentration and volume, and in terms of sensory versus motor block

tive analgesia for up to 3 days.[124] This formulation has been used off-label for incisional anaesthesia (see later).[124]

Commonly used local anaesthetics are presented in Table 8.[118,125] Local anaesthetic toxicity can result in severe neurological signs, cardiorespiratory collapse and death. Therefore, calculation of doses, which must always be accurately drawn up into syringes, is particularly important in cats due to their small size, especially with bupivacaine due to its cardiotoxicity. Accidental intravascular administration can be avoided by applying negative pressure to the syringe plunger before injection[118,125] and repositioning the needle if blood is obtained. The most serious adverse effect reported for local anaesthetics is cardiac arrest and intravenous administration of lipid emulsion may reverse bupivacaine-induced toxicity.[127]

Lumbosacral epidural administration of opioids combined with local anaesthetics is sometimes used for the treatment of feline perioperative pain, particularly during orthopaedic procedures or hindlimb amputation. In cats, the spinal cord and dural sac terminate at the first (S1) and third (S3) sacral vertebra, respectively, while the end of the conus medullaris is located within the sacral canal (Figure 13).[128] These anatomical features make the risk of intrathecal drug administration more likely compared with dogs.[128]

Sacrococcygeal epidural anaesthesia has been used as an alternative to lumbosacral epidural injections for cats with urethral obstruction (Figure 14).[129,130] A sacrococcygeal technique using bupivacaine or bupivacaine/morphine reduced propofol requirements and extended the time to rescue analgesia in these cats.[129] Anatomical and ultrasonographic studies have shown that the depth of needle insertion for sacrococcygeal epidural anaesthesia is approximately 0.6 cm in cats, whereas the distance between skin and the ligamentum flavum is 1 cm at the lumbosacral space.[131] The epidural space is small in cats but the technique can provide excellent perioperative analgesia and be performed safely. Appropriate anatomical landmarks should be considered and an aseptic technique used.

Figure 14 Sacrococcygeal epidural administration of local anaesthetics can be used in cats with urethral obstruction as an adequate means of pain management. Leakage of spinal fluid is less likely at this location but can occur, as shown in this image. *Image courtesy of Paulo Steagall*

Selected local and regional anaesthetic techniques

Several local anaesthetic techniques have been reported in cats, including sophisticated ultrasound-guided techniques, allowing a better understanding of anatomical landmarks, and improved safety and efficacy. These Guidelines provide an overview of easy-to-use, selected techniques with immediate application in feline practice (Table 9).

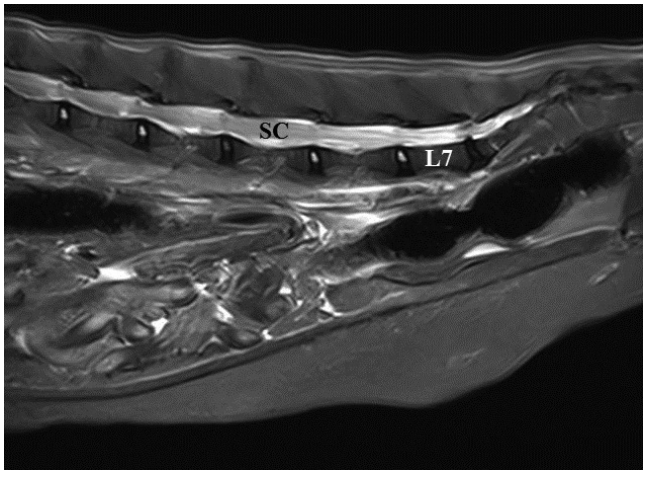

Figure 13 Magnetic resonance image of a feline lumbar and sacral spinal column. Note the spinal cord (SC) extending beyond the 7th lumbar (L7) vertebra. *Image courtesy of Wade Friedeck, Texas A&M University College of Veterinary Medicine & Biomedical Sciences*

Advantages of locoregional anaesthetic techniques – in addition to opioid-sparing – include low cost, drug accessibility, muscle relaxation, and decreases in injectable and volatile anaesthetic requirements.

Topical local anaesthesia

The administration of topical anaesthesia is simple and effective. In one study of cats undergoing radical mastectomy, topical application of 2 mg/kg bupivacaine in 30 ml of saline 0.9% via impregnated gauze decreased pain scores at 4 h postoperatively.[133]

Although placing an intravenous catheter may seem a minor procedure, it should be remembered that each painful procedure a cat undergoes can have an additive effect and, therefore, every opportunity should be taken to decrease pain and stress. Topical local anaesthetic cream (lidocaine–prilocaine) (Table 9) reduces pain and stress during intravenous puncture or catheteristion (Figure 15), and is not systemically absorbed, thus methaemoglobinaemia or other adverse effects are avoided.[126,134–136] In addition, the success rate for catheterisation is improved.[128]

VIDEO RESOURCES

The local and regional anaesthetic techniques discussed in these Guidelines, together with other pain management techniques, can be watched on the YouTube channel of the Faculty of Veterinary Medicine, Université de Montréal: youtube.com/channel/UCaDaAco76nwBq7BWEO-dLcA/search?query=steagall as well as courtesy of Matt Gurney at Zero Pain Philosophy: zeropainphilosophy.com/local-anaesthetic-videos

Figure 15 **A eutectic mixture of local anaesthetics (lidocaine and prilocaine cream) is used to desensitise the skin before venous catheterisation. The area is covered with an occlusive bandage for 20–30 mins before venepuncture. Adverse reactions have not been reported in cats.** *Image courtesy of Paulo Steagall*

Table 9 **Summary of common local anaesthetic techniques used in cats**

Technique	Indications	Needle	Volume of local anaesthetic*	Landmarks	Comments
Topical anaesthesia (lidocaine–prilocaine cream) (Figure 15)	Pain and stress associated with intravenous puncture or catheterisation	Not applicable (cream applied to skin)	1 ml	Over the vein	Apply cream to clipped skin and cover with an occlusive bandage. Wait for onset – 20–30 mins in non-sedated cats
Incisional (infiltration) analgesia (Figure 16)	OVH, castration and any other surgical procedure	22–27 G, 1–1.5 inch	1–2 ml or 0.4 ml/kg have been suggested, but generally this will depend on the length of the incision and on local anaesthetic concentration	Incision area	Can be performed prior to incision, but also after surgery for postoperative analgesia. It is recommended that the local anaesthetic is diluted if long incision/large volume is required
Intraperitoneal analgesia (Figure 17)	OVH and other abdominal surgeries	22 G, 1.16 inch catheter (without stylet)	2 mg/kg 0.5% bupivacaine (0.4 ml/kg) diluted 1:1 with saline 0.9% (ie, 0.8 ml/kg)	Ovary pedicles and caudal uterine body, or 'splash' over the area of interest	Caution should be taken not to exceed the maximum recommended dose for cats (Table 8)
Intratesticular block (Figure 18)	Castration	25 G, 5/8 inch	0.1–0.25 ml per testis	Into the centre of each testis	The testes become firm. Combination with incisional infiltration is recommended
Dental blocks: ***Infraorbital*** (Figures 19 [needle A] and 20) ***Inferior alveolar (mandibular)*** (Figures 19 [needle B] and 21)	Dental cleaning, extractions, sutures, fracture repair, oral mass removal, maxillectomy and mandibulectomy	25 G, 5/8 inch or 27 G, 0.5 inch	0.1–0.3 ml at each nerve (usually 0.2 ml per site)	*Infraorbital* Above premolar 3, into the infraorbital canal (4–5 mm). The infraorbital canal is short in cats and the needle should be introduced with caution to avoid globe penetration *Inferior alveolar (mandibular)* The lower angle of the jaw, against the medial side of the mandible in the direction of the mandibular foramen	*Infraorbital* Blocks innervation to the skin, hard and soft tissues of the rostral maxillae, including the teeth and dorsal nasal cavity *Inferior alveolar (mandibular)* Blocks innervations of the mandible including teeth, lower lip, part of the tongue, and hard and soft tissues

The information in this table represents a consensus of opinion of the Guidelines panel members
*Refer to Table 8 for the maximum recommended dose of the particular drug being used, to avoid toxicity
OVH = ovariohysterectomy

Incisional and intraperitoneal analgesia

The World Small Animal Veterinary Association (WSAVA) Global Pain Council recently published an evidence-based review on incisional (Figure 16) and intraperitoneal (Figure 17) techniques.[137] Readers are referred to that resource for a detailed discussion of indications and recommendations for use, as well as limitations. These techniques should be incorporated into multimodal pain management.[132,138–143]

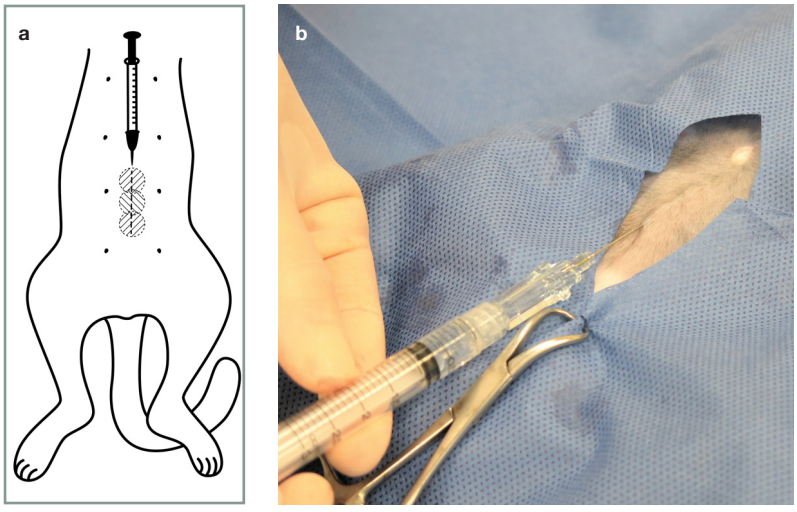

Figure 16 **(a,b) Incisional anaesthesia is performed before or at the end of surgery by deposition of local anaesthetic subcutaneously at the incision line.** *Image (a) courtesy of Yael-Shilo Benjamini; image (b) courtesy of Paulo Steagall*

Intratesticular block

Intratesticular anaesthesia is a simple technique that may decrease sympathetic and haemodynamic responses during feline castration (Figure 18).[120,144,145] It can be combined with incisional anaesthesia for complete antinociception (Figure 18b [needle B]). This technique should be performed under general anaesthesia or deep sedation, as injection and distension of the testicle can be painful.

Dental blocks

There are many blocks that can be used for a variety of dental and oral procedures including extractions, oral mass removal, biopsies, maxillectomy and mandibulectomy. Injections are performed using 25–27 G needles and volumes of lidocaine of 0.1–0.3 ml at each nerve;[25,125,146] however, the total dose guidelines (mg/kg, Table 8) must be adhered to. The final injectate volume will depend on the number of dental blocks to be performed. Care must be taken to carefully track the amount of drug administered, especially when injecting at multiple sites.

The infraorbital nerve block is shown in Figure 19 (needle A) and Figure 20. The maxillary nerve courses through the inferior periorbita and enters the infraorbital canal, where it becomes the infraorbital nerve.[147,148] The needle should be inserted with caution into the infraorbital canal, no further than 4–5 mm, to avoid the risk of penetration of the eyeball,

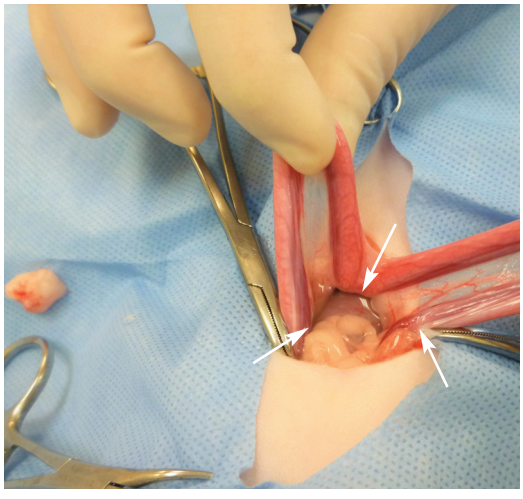

Figure 17 **Intraperitoneal administration of local anaesthetic is performed before ovariectomy/ovariohysterectomy and other abdominal procedures. Local anaesthetics with a longer duration of action (ie, bupivacaine) are used, and the solution is divided into three parts, which are 'splashed' over the right and left ovarian pedicles and at the caudal aspect of the uterine body (arrows) using a 3 ml syringe. The solution is quickly absorbed by the peritoneum. A technique involving injecting bupivacaine (2 mg/kg) at the ovarian suspensory ligaments and vessels, uterine body and incisional subcutaneous tissues has also been described;[132] it resulted in lower postoperative pain scores compared with a control group and was most beneficial in larger cats (>2.7 kg).** *Image courtesy of Paulo Steagall*

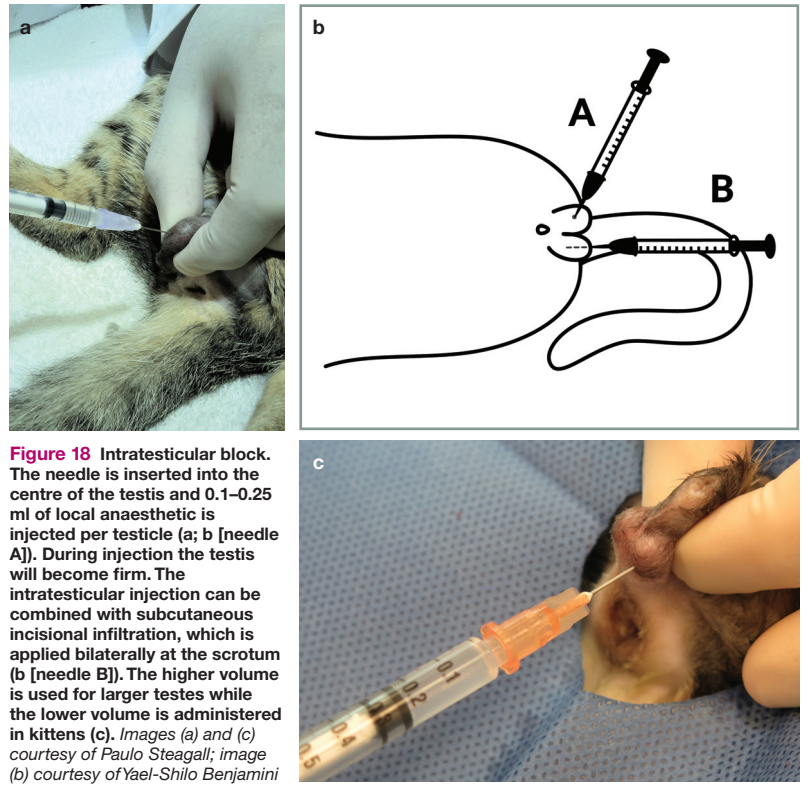

Figure 18 **Intratesticular block. The needle is inserted into the centre of the testis and 0.1–0.25 ml of local anaesthetic is injected per testicle (a; b [needle A]). During injection the testis will become firm. The intratesticular injection can be combined with subcutaneous incisional infiltration, which is applied bilaterally at the scrotum (b [needle B]). The higher volume is used for larger testes while the lower volume is administered in kittens (c).** *Images (a) and (c) courtesy of Paulo Steagall; image (b) courtesy of Yael-Shilo Benjamini*

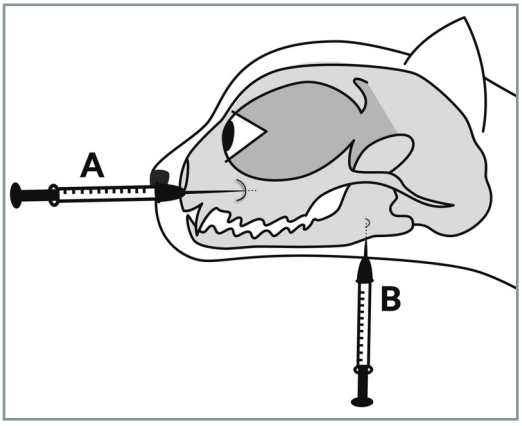

Figure 19 **Locations for the infraorbital nerve block (needle A) and inferior alveolar (mandibular) nerve block (needle B). The techniques are illustrated photographically in Figures 20 and 21, respectively.** *Image courtesy of Yael-Shilo Benjamini*

Figure 20 **Infraorbital nerve block. The needle is inserted from a cranial to caudal direction at the level of premolar 3, approximately 4–5 mm into the infraorbital canal.** *Image courtesy of Paulo Steagall*

especially in brachycephalic cats.[149] The efficacy of this nerve block for caudal teeth (ie, feline premolar 3 and molar 1) anaesthesia has not been established in cats.[147] A maxillary nerve block has been performed as an alternative for anaesthesia of the caudal teeth, but there are reports suggesting an increased risk of penetrating the globe and, therefore, it is no longer recommended.[150,151]

The inferior alveolar (mandibular) nerve (Figure 19 [needle B] and Figure 21) enters the mandibular canal via the mandibular foramen on the medial surface of the mandibular ramus.[121,148] Cardiovascular collapse was reported in a cat with a mandibular mass following inferior alveolar (mandibular) anaesthesia using bupivacaine.[152] Injection in close proximity to the tumour may have resulted in rapid bupivacaine absorption and toxic peak plasma concentrations.[152]

Figure 21 **Inferior alveolar (mandibular) nerve block using an extraoral approach. The needle is inserted, perpendicularly to the skin surface, at the lower angle of the jaw, and advanced approximately 5 mm against the medial side of the mandible in the direction of the mandibular foramen.** *Image courtesy of Yael-Shilo Benjamini*

Adjuvant analgesic drugs

✣ **Alpha-2 agonists** are useful in the perioperative period for premedication/sedation/chemical restraint[153] as they also provide muscle relaxation and some analgesia. Sedation/anxiolysis may reduce the overall 'pain experience'. Drugs with higher specificity for the alpha-2 adrenergic receptors (medetomidine and dexmedetomidine) are preferred over xylazine. Alpha-2 agonists should not be used as 'stand-alone' analgesics, but rather incorporated into multimodal protocols. However, their use should be reserved for cats with stable cardiovascular function. Antagonists of alpha-2 adrenergic receptors (eg, atipamezole) should always be available for drug reversal and may be required during prolonged recoveries or when cardiovascular collapse is observed.

✣ **Metamizole (dipyrone)** is a phenolic compound and atypical NSAID with COX-1 and some COX-2 anti-inflammatory activity.[154] The drug has potent analgesic effects that may be due to central inhibition of the COX-3 enzyme.[155] Activation of the opioid and cannabinoid systems is also a possible mechanism of action for metamizole.[156] This is a popular analgesic drug, particularly in South America, where it has been used for perioperative pain management in dogs and cats undergoing ovariohysterectomy.[154,157,158] In cats, the pharmacokinetics of the two major metabolites of metamizole were described after IV, IM and PO administration (25 mg/kg). Salivation and vomiting were observed in four and two (out of six) cats after IV and IM administration, respectively.[159] However, a further study did not report these adverse effects after IV metamizole (25 mg/kg q8, 12 or 24 h). Indeed, the administration of metamizole did not

produce any clinically relevant effects on Heinz body formation, biochemical profile or oxidation markers in cats undergoing ovariohysterectomy, although neither did it have an additional analgesic effect in this study in cats receiving injectable tramadol.[158] In another investigation, metamizole induced sialorrhoea when administered orally (drops) in the home environment to cats following ovariohysterectomy; rescue analgesia was required for some cats receiving either 12.5 mg/kg q12h or 25 mg/kg q24h, showing that unimodal therapy (similar to meloxicam) may not induce adequate analgesia.[154]

✣ **Gabapentin** binds to voltage-gated calcium channels, but other mechanisms of action have been identified including activation of the descending noradrenergic inhibitory system.[160] The drug has high bioavailability in cats (90–95%) following oral administration of 10 mg/kg; peak plasma concentrations occur at between 45 mins and 2 h, and elimination half-lives were reported to be between 3 and 4 h.[161,162] Repeated dosing did not affect terminal half-life and other pharmacokinetic parameters.[161]

Transdermal administration of drugs is an attractive alternative to oral dosing in cats. The choice of base used to mix drugs with is important since it must be able to permeate feline skin. One study showed no significant transdermal absorption of gabapentin when compounded with ethoxydiglycol solvent and a transdermal base (Lipoderm; Professional Compounding Centers of America).[161] However, another study showed that gabapentin in the proprietary base Lipoderm did result in measurable plasma concentrations.[163] The authors of the latter study caution that their investigation involved a small number of cats and, because grooming was allowed, uptake may have occurred transmucosally. More studies using different transdermal creams, concentrations, doses and dosing intervals are needed.

There is limited information on the use of gabapentin for acute pain management.[35,55,164] In one study, gabapentin (50 mg, PO, administered 12 h and 1 h before surgery) in combination with buprenorphine produced similar postoperative analgesia when compared with meloxicam and buprenorphine in cats undergoing ovariohysterectomy.[35] Further studies are thus still required to investigate the analgesic properties of gabapentinoids in cats. Gabapentin (50 or 100 mg, PO) is important in attenuating stress and fear responses in client-owned and cage-trap community cats undergoing transportation and veterinary consultation, and remains a valuable component of a holistic approach to feline pain management.[60,165]

Further studies are required to investigate the analgesic properties of gabapentinoids in cats.

✣ **Ketamine** produces anti-hyperalgesic effects at subanaesthetic doses by non-competitive and non-specific antagonism of NMDA receptors.[57,166] These receptors are important in excitatory and sustained neurotransmission in the dorsal horn of the spinal cord. NMDA receptors are involved in the development and maintenance of central sensitisation (Table 4) and cumulative depolarisation. Therefore, ketamine is used to prevent and treat hyperalgesia and allodynia in cats with major injury and in those undergoing surgery for its anaesthetic- and opioid-sparing effects.[55,80] Cats that undergo long-term therapy (days) must be hospitalised during treatment and pain should be monitored appropriately. Suggested dosing is as follows: an intravenous loading dose of 0.15–0.3 mg/kg followed by an infusion of 2–10 μg/kg/min.

✣ **Tramadol** is a synthetic weak opioid agonist and a serotonin and noradrenaline reuptake inhibitor (dual action) analgesic drug. The injectable formulation is commonly used in some countries, especially in South America, whereas in North America, Oceania and most countries in Europe the drug is only available in an oral formulation. However, its low palatability (bitter taste) has precluded it from becoming a popular perioperative analgesic in cats. Cats may salivate profusely after drug administration and treatment compliance can be poor. Moreover, there is significant inter-patient variability in analgesic efficacy and adverse effects of tramadol in cats. Injectable formulations of tramadol (2–4 mg/kg IM) are often combined with acepromazine or dexmedetomidine for premedication.[167,168]

Based on the pharmacokinetics of tramadol in cats, a dosage of 4 mg/kg q6h PO has been recommended as part of a multimodal analgesic plan.[169] However, tramadol has failed to produce clinical analgesia in some studies, and pain assessment should always be performed.[167] The risk of serotonin toxicity is a concern when tramadol is administered with serotonin inhibitors (eg, fluoxetine and trazodone), monoamine oxidase inhibitors (eg, selegiline) and tricyclic antidepressants (eg, clomipramine). Clinical signs of serotonin syndrome include increased neuromuscular activity, tachycardia, fever, tachypnoea and agitation.[170]

Analgesic shortages and unavailability: opioid-free or opioid-sparing techniques

Opioids are included in the WSAVA list of essential medicines for cats and dogs, and considered 'core medicines'.[171] Nevertheless, veterinarians commonly face opioid shortages or do not always have access to this class of drug due to strict regulatory and bureaucratic constraints, and/or where medicines labelled for human use are rarely allowed to be administered to veterinary patients. These constraints affect the ability of veterinarians to treat feline pain, and this could represent a major issue for feline welfare if surgical and medical procedures are performed with limited or no perioperative analgesia.

'Opioid-free anaesthesia' (OFA) is a practice that excludes perioperative administration of opioids and uses non-opioid, multimodal analgesic techniques. 'Opioid-sparing anaesthesia' is a less restrictive technique where small amounts of opioids are used (ie, single and/or low doses of opioids perioperatively). Both techniques are now being studied in human medicine to avoid or reduce opioid-induced adverse effects, including respiratory depression and death.[172–174] Although adverse effects are different between humans and cats, the study of feline OFA is integral to overcoming opioid shortages in the future and reducing opioid-induced adverse effects (vomiting, dysphoria, hyperthermia, etc). There is also an urgent need to provide humane solutions for pain management in sterilisation programmes, which have often been performed without the use of analgesics.

The veterinary literature on the subject is scant, particularly in cats. In one study, an injectable anaesthetic protocol using ketamine–midazolam and dexmedetomidine, intraperitoneal bupivacaine and postoperative administration of meloxicam did not provide optimal postoperative analgesia in more than half of the studied population.[175] Side-by-side comparisons were not performed between an opioid-based analgesic group and an OFA group,[175] and the question of 'can we attenuate or ameliorate acute pain without opioids?' remains. Certainly, opioid analgesics with market authorisation for cats are critical to avoid opioid drug shortages and improve feline welfare. This issue is best addressed by involving multiple stakeholders including, but not limited to, governmental bodies, industry, regulatory agencies and veterinary professionals.

Note for readers
Ultimate responsibility for interpretation of the information in these Guidelines lies with the veterinary practitioner. The Guidelines may describe the use of products, formulations, methods or techniques that are not necessarily available or licensed for use in cats in a reader's own country.

Knowledge gaps and challenges

There is still a need for better understanding of feline behaviour related to pain as well as techniques for long-term pain management in the acute setting so that cats can be discharged to their owner with analgesics that continue to work in the home environment and are easy for owners to administer. Opioid-free anaesthetic techniques and the role of gabapentinoids are important to investigate. Little is known about paediatric analgesic needs, warranting further studies in this age group. There is also a need for safety and efficacy studies of in vivo locoregional anaesthetic techniques to bridge the gap between in vitro studies and clinical practice. A major gap remains to be filled in the veterinary curriculum regarding feline analgesia and there must be a concerted effort to implement the use of pain assessment tools in feline practice.

Supplementary material

The following files are available online:
- Troubleshooting dysphoria algorithm
- Cat Carer Guide: 'Recognising and managing acute pain in cats: information for owners/caregivers' (see Appendix, page 30).

SUMMARY POINTS

- The 2022 ISFM Consensus Guidelines on the Management of Acute Pain in Cats provide up-to-date information on the unique features of feline anatomy, physiology and pharmacology in relation to analgesia, as well as on pain assessment tools and novel analgesic drugs and techniques.
- Principles of pain management include preventive analgesia and multimodal analgesia, incorporating pharmacological and non-pharmacological options. The use of cat friendly handling techniques, anxiolysis and nursing care are central to appropriate pain management.
- In addition to local anaesthetics, NSAIDs and opioids, adjuvant analgesics should be considered depending on the individual and its needs.
- The future is bright for feline pain management with the potential automation of acute pain assessment tools that could allow cat owners to detect pain in the home environment, the licensing of new analgesic drugs for perioperative pain control and studies on novel analgesic drugs and techniques.
- Gaps in knowledge and challenges remain, but the good news is that these can be addressed with research support, educational opportunities and an enthusiastic group of feline advocates.

Acknowledgements

ISFM is grateful to Dr Sabrine Marangoni for technical help with formatting the Guidelines, and to Nirit Roth-Benyamini for help in creating Figures 16a, 18b and 19.

Conflict of interest

Paulo V Steagall has provided consultancy services to, and received honoraria from, Boehringer Ingelheim, Dechra, Elanco, Nexyon, Vetoquinol and Zoetis. Sheilah Robertson has provided consultancy services to, and received honoraria from, Elanco and Zoetis. The other members of the Panel have no conflicts of interest to declare.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

Ethical approval

This work did not involve the use of animals and, therefore, ethical approval was not specifically required for publication in *JFMS*.

Informed consent

This work did not involve the use of animals (including cadavers) and, therefore, informed consent was not required. For any animals or people individually identifiable within this publication, informed consent (verbal or written) for their use in the publication was obtained from the people involved.

References

1 American Veterinary Medical Association. **U.S. pet ownership statistics**. https://www.avma.org/resources-tools/reports-statistics/us-pet-ownership-statistics (2020, accessed 20 November 2021).
2 Canadian Veterinary Medical Association. **Veterinary demographics (2020).** https://www.canadianveterinarians.net/about/statistics (2021, accessed 15 July 2021).
3 Steagall PV, Monteiro BP and Taylor PM. **A review of the studies using buprenorphine in cats.** *J Vet Intern Med* 2014; 28: 762–770.
4 Bortolami E and Love EJ. **Practical use of opioids in cats: a state-of-the-art, evidence-based review.** *J Feline Med Surg* 2015; 17: 283–311.
5 Steagall PV and Monteiro BP. **Acute pain in cats: recent advances in clinical assessment.** *J Feline Med Surg* 2019; 21: 25–34.
6 Robertson S. **How do we know they hurt? Assessing acute pain in cats.** *In Pract* 2018; 40: 440–448.
7 Reid J, Scott EM, Calvo G, et al. **Definitive Glasgow acute pain scale for cats: validation and intervention level.** *Vet Rec* 2017; 180: 449. DOI: 10.1136/vr.104208.
8 Evangelista MC, Watanabe R, Leung VSY, et al. **Facial expressions of pain in cats: the development and validation of a Feline Grimace Scale.** *Sci Rep* 2019; 9: 1–11. DOI: 10.1038/s41598-019-55693-8.
9 Belli M, de Oliveira AR, de Lima MT, et al. **Clinical validation of the short and long UNESP-Botucatu scales for feline pain assessment.** *PeerJ* 2021; 12; 9. DOI: 10.7717/peerj.11225.
10 Holden E, Calvo G, Collins M, et al. **Evaluation of facial expression in acute pain in cats.** *J Small Anim Pract* 2014; 55: 615–621.
11 Steagall PV, Monteiro BP, Ruel HLM, et al. **Perceptions and opinions of Canadian pet owners about anaesthesia, pain and surgery in small animals.** *J Small Anim Pract* 2017; 58: 380–388.
12 Simon BT, Scallan EM, Von Pfeil DJF, et al. **Perceptions and opinions of pet owners in the United States about surgery, pain management, and anesthesia in dogs and cats.** *Vet Surg* 2018; 47: 277–284.
13 Rae L, MacNab N, Bidner S, et al. **Attitudes and practices of veterinarians in Australia to acute pain management in cats.** *J Feline Med Surg*. Epub ahead of print 20 September 2021. DOI: 10.1177/1098612X211043086.
14 Hunt JR, Knowles TG, Lascelles BDX, et al. **Prescription of perioperative analgesics by UK small animal veterinary surgeons in 2013.** *Vet Rec* 2015; 176: 493. DOI: 10.1136/vr.102834.
15 Coleman DL and Slingsby LS. **Attitudes of veterinary nurses to the assessment of pain and the use of pain scales.** *Vet Rec* 2007; 160: 541–544.
16 Simon BT, Scallan EM, Carroll G, et al. **The lack of analgesic use (oligoanalgesia) in small animal practice.** *J Small Anim Pract* 2017; 58: 543–554.
17 Rodan I, Sundahl E, Carney H, et al. **AAFP and ISFM feline-friendly handling guidelines.** *J Feline Med Surg* 2011; 13: 364–375.
18 Feline Grimace Scale. **Pain assessment in cats.** https://www.felinegrimacescale.com (2020, accessed 18 November 2021).
19 Animal Pain. http://www.animalpain.com.br/en-us/ (2012, accessed 19 July 2019).
20 New Metrica. **Acute pain measurement.** https://www.newmetrica.com/acute-pain-measurement/ (2019, accessed 19 July 2021).
21 Cambridge AJ, Tobias KM, Newberry RC, et al. **Subjective and objective measurements of postoperative pain in cats.** *J Am Vet Med Assoc* 2000; 217: 685–690.
22 Smith JD, Allen SW, Quandt JE, et al. **Indicators of postoperative pain in cats and correlation with clinical criteria.** *Am J Vet Res* 1996; 57: 1674–1678.
23 Smith JD, Allen SW and Quandt JE. **Changes in cortisol concentration in response to stress and postoperative pain in client-owned cats and correlation with objective clinical variables.** *Am J Vet Res* 1999; 60: 432–436.
24 Brondani JT, Mama KR, Luna SPL, et al. **Validation of the English version of the UNESP-Botucatu multidimensional composite pain scale for assessing postoperative pain in cats.** *BMC Vet Res* 2013; 9: 143. DOI: 10.1186/1746-6148-9-143.
25 Watanabe R, Frank D and Steagall PV. **Pain behaviors before and after treatment of oral disease in cats using video assessment: a prospective, blinded, randomized clinical trial.** *BMC Vet Res* 2020; 16: 1–11. DOI: 10.1186/s12917-020-02302-w.
26 Waran N, Best L and Williams V. **A preliminary study of behaviour-based indicators of pain in cats.** *Anim Welf* 2007; 16: 105–108.
27 Steagall PV. **Analgesia: what makes cats different/challenging and what is critical for cats?** *Vet Clin North Am Small Anim Pract* 2020; 50: 749–767.
28 Calvo G, Holden E, Reid J, et al. **Development of a behaviour-based measurement tool with defined intervention level for assessing acute pain in cats.** *J Small Anim Pract* 2014; 55: 622–629.
29 Evangelista MC, Benito J, Monteiro BP, et al. **Clinical applicability of the Feline Grimace Scale: real-time versus image scoring and the influence of sedation and surgery.** *PeerJ* 2020; 8. DOI: 10.7717/peerj.8967.
30 Watanabe R, Doodnaught GM, Evangelista MC, et al. **Inter-rater reliability of the Feline Grimace Scale in cats undergoing dental extractions.** *Front Vet Sci* 2020; 7: 4–9. DOI: 10.3389/ fvets.2020.00302.
31 Steagall PV, Monteiro BP, Lavoie A, et al. **Validation of the French version of a multidimensional composite scale for the assess-**

ment of postoperative pain in cats [article in French]**.** *Can Vet J* 2017; 58: 56–64.
32 Della Rocca G, Catanzaro A, Conti MB, et al. **Validation of the Italian version of the UNESP-Botucatu Multidimensional Composite Pain Scale for the assessment of postoperative pain in cats.** *Vet Ital* 2018; 54: 49–61.
33 Evangelista MC and Steagall PV. **Agreement and reliability of the Feline Grimace Scale among cat owners, veterinarians, veterinary students and nurses.** *Sci Reports* 2021; 11: 5262. DOI: 10.1038/s41598-021-84696-7.
34 Benito J, Monteiro BP, Beauchamp G, et al. **Evaluation of inter-observer agreement for postoperative pain and sedation assessment in cats.** *J Am Vet Med Assoc* 2017; 251: 544–551.
35 Steagall PV, Benito J, Monteiro BP, et al. **Analgesic effects of gabapentin and buprenorphine in cats undergoing ovariohysterectomy using two pain-scoring systems: a randomized clinical trial.** *J Feline Med Surg* 2018; 20: 741–748.
36 Doodnaught GM, Benito J, Monteiro BP, et al. **Agreement among undergraduate and graduate veterinary students and veterinary anesthesiologists on pain assessment in cats and dogs: a preliminary study.** *Can Vet J* 2017; 58: 805–808.
37 Benito J and Steagall PV. **Postoperative analgesia between non-pregnant healthy cats versus pregnant or cats with upper respiratory tract disease** [abstract]**.** *Vet Anaesth Analg* 2017; 44: 195.
38 Buisman M, Hasiuk MMM, Gunn M, et al. **The influence of demeanor on scores from two validated feline pain assessment scales during the perioperative period.** *Vet Anaesth Analg* 2017; 44: 646–655.
39 Buisman M, Wagner MC, Hasiuk MM, et al. **Effects of ketamine and alfaxalone on application of a feline pain assessment scale.** *J Feline Med Surg* 2016; 18: 643–651.
40 Simon BT, Scallan EM, Baetge CL, et al. **The antinociceptive effects of intravenous administration of three doses of butorphanol tartrate or naloxone hydrochloride following hydromorphone hydrochloride to healthy conscious cats.** *Vet Anaesth Analg* 2019; 46: 538–547.
41 Robertson S, Gogolski SM, Pascoe P, et al. **AAFP feline anesthesia guidelines.** *J Feline Med Surg* 2018; 20: 602–634.
42 Väisänen MA-M, Tuomikoski SK and Vainio OM. **Behavioral alterations and severity of pain in cats recovering at home following elective ovariohysterectomy or castration.** *J Am Vet Med Assoc* 2007; 231: 236–242.
43 Adrian D, Papich M, Baynes R, et al. **Chronic maladaptive pain in cats: a review of current and future drug treatment options.** *Vet J* 2017; 230: 52–61.
44 Steagall PV, Bustamante H, Johnson CB, et al. **Pain management in farm animals: focus on cattle, sheep and pigs.** *Animals* 2021; 11: 1483. DOI: 10.3390/ani11061483.
45 Humble SR, Dalton AJ and Li L. **A systematic review of therapeutic interventions to reduce acute and chronic post-surgical pain after amputation, thoracotomy or mastectomy.** *Eur J Pain* 2015; 19: 451–465.
46 Weibel S, Neubert K, Jelting Y, et al. **Incidence and severity of chronic pain after caesarean section.** *Eur J Anaesthesiol* 2016; 33: 853–865.
47 Court MH. **Feline drug metabolism and disposition: pharmacokinetic evidence for species differences and molecular mechanisms.** *Vet Clin North Am Small Anim Pract* 2013; 43: 1039–1054.
48 Court MH and Greenblatt DJ. **Molecular genetic basis for deficient acetaminophen glucuronidation by cats: UGT1A6 is a pseudogene, and evidence for reduced diversity of expressed hepatic UGT1A isoforms.** *Pharmacogenetics* 2000; 10: 355–369.
49 Taylor P, Delatour P, Landont F, et al. **Pharmacodynamics and enantioselective pharmacokinetics of carprofen in the cat.** *Res Vet Sci* 1996; 60: 144–151.
50 Taylor PM, Robertson SA, Dixon MJ, et al. **Morphine, pethidine and buprenorphine disposition in the cat.** *J Vet Pharmacol* 2002; 24: 391–398.
51 Grude P, Guittard J, Garcia C, et al. **Excretion mass balance evaluation, metabolite profile analysis and metabolite identification in plasma and excreta after oral administration of [14C]-meloxicam to the male cat: preliminary study.** *J Vet Pharmacol* 2010; 33: 396–407.
52 Lehr T, Narbe R, Jöns O, et al. **Population pharmacokinetic modelling and simulation of single and multiple dose administration of meloxicam in cats.** *J Vet Pharmacol Ther* 2009; 33: 277–286.
53 Sparkes AH, Caney S, Chalhoub S, et al. **ISFM consensus guidelines on the diagnosis and management of feline chronic kidney disease.** *J Feline Med Surg* 2016; 18: 219–239.
54 Monteiro B, Steagall PV, Lascelles BDX, et al. **Long-term use of non-steroidal anti-inflammatory drugs in cats with chronic kidney disease: from controversy to optimism.** *J Small Anim Pract* 2019; 60: 459–462.
55 Steagall PV and Monteiro BP. **Multimodal analgesia for perioperative pain in three cats.** *J Feline Med Surg* 2013; 15: 737–743.
56 Goich M, Bascuñán A, Faúndez P, et al. **Multimodal analgesia for treatment of allodynia and hyperalgesia after major trauma in a cat.** *JFMS Open Rep* 2019; 5. DOI: 10.1177/2055116919855809.
57 Ruel HLM and Steagall PV. **Adjuvant analgesics in acute pain management.** *Vet Clin North Am Small Anim Pract* 2019; 49: 1127–1241.
58 Hickman MA, Cox SR, Mahabir S, et al. **Safety, pharmacokinetics and use of the novel NK-1 receptor antagonist maropitant (Cerenia™) for the prevention of emesis and motion sickness in cats.** *J Vet Pharmacol Ther* 2008; 31: 220–229.
59 Santos LCP, Ludders JW, Erb HN, et al. **A randomized, blinded, controlled trial of the antiemetic effect of ondansetron on dexmedetomidine-induced emesis in cats.** *Vet Anaesth Analg* 2011; 38: 320–327.
60 Van Haaften KA, Forsythe LRE, Stelow EA, et al. **Effects of a single preappointment dose of gabapentin on signs of stress in cats during transportation and veterinary examination.** *J Am Vet Med Assoc* 2017; 251: 1175–1181.
61 Stevens BJ, Frantz EM, Orlando JM, et al. **Efficacy of a single dose of trazodone hydrochloride given to cats prior to veterinary visits to reduce signs of transport- and examination-related anxiety.** *J Am Vet Med Assoc* 2016; 249: 202–207.
62 Wright B, Kronen PW, Lascelles D, et al. **Ice therapy: cool, current and complicated.** *J Small Anim Pract* 2020; 61: 267–271.
63 Carney HC, Little S, Brownlee-Tomasso D, et al. **AAFP and ISFM feline-friendly nursing care guidelines.** *J Feline Med Surg* 2012; 14: 337–349.
64 Slingsby LS, Bortolami E and Murrell JC. **Methadone in combination with medetomidine as premedication prior to ovariohysterectomy and castration in the cat.** *J Feline Med Surg* 2015; 17: 864–872.
65 Camargo JB, Steagall PV, Minto BW, et al. **Post-operative analgesic effects of butorphanol or firocoxib administered to dogs undergoing elective ovariohysterectomy.** *Vet Anaesth Analg* 2011; 38: 252–259.
66 Taylor PM, Luangdilok C and Sear JW. **Pharmacokinetic and pharmacodynamic evaluation of high doses of buprenorphine delivered via high-concentration formulations in cats.** *J Feline Med Surg* 2016; 18: 290–302.
67 Portela DA, Verdier N and Otero PE. **Regional anesthetic techniques for the limb and thorax in small animals: a review of the literature and technique description.** *Vet J* 2018; 241: 8–19. DOI: 10.1016/j.tvjl.2018.09.006.

68 Portela DA, Verdier N and Otero PE. **Regional anesthetic techniques for the pelvic limb and abdominal wall in small animals: a review of the literature and technique description.** *Vet J* 2018; 238: 27–40.

69 Bradbrook CA and Clark L. **State of the art analgesia – recent developments in pharmacological approaches to acute pain management in dogs and cats. Part 1.** *Vet J* 2018; 238: 76–82.

70 Go VL and Yaksh TL. **Release of substance P from the cat spinal cord**. *J Physiol* 1987; 391: 141–167.

71 Torrecilla M, Marker CL, Cintora SC, et al. **G-protein-gated potassium channels containing Kir3.2 and Kir3.3 subunits mediate the acute inhibitory effects of opioids on locus ceruleus neurons.** *J Neurosci* 2002; 22: 4328–4334.

72 Mansour A, Fox CA, Thompson RC, et al. **μ-opioid receptor mRNA expression in the rat CNS: comparison to μ-receptor binding.** *Brain Res* 1994; 643: 245–265.

73 Taddese A, Nah S-Y and McCleskey EW. **Selective opioid inhibition of small nociceptive neurons.** *Science* 1995; 270: 1366–1369.

74 Pascoe PJ, Ilkiw JE and Fisher LD. **Cardiovascular effects of equipotent isoflurane and alfentanil/isoflurane minimum alveolar concentration multiple in cats.** *Am J Vet Res* 1997; 58: 1267–1273.

75 Ilkiw JE, Pascoe PJ and Tripp LD. **Effects of morphine, butorphanol, buprenorphine, and U50488H on the minimum alveolar concentration of isoflurane in cats.** *Am J Vet Res* 2002; 63: 1198–1202.

76 Steffey EP, Eisele JH, Baggot JD, et al. **Influence of inhaled anesthetics on the pharmacokinetics and pharmacodynamics of morphine.** *Anesth Analg* 1993; 77: 346–351.

77 Brosnan RJ, Pypendop BH, Siao KT, et al. **Effects of remifentanil on measures of anesthetic immobility and analgesia in cats.** *Am J Vet Res* 2009; 70: 1065–1071.

78 Ferreira TH, Aguiar AJA, Valverde A, et al. **Effect of remifentanil hydrochloride administered via constant rate infusion on the minimum alveolar concentration of isoflurane in cats.** *Am J Vet Res* 2009; 70: 581–588.

79 Monteiro ER, Teixeira-Neto FJ, Campagnol D, et al. **Effects of remifentanil on the minimum alveolar concentration of isoflurane in dogs.** *Am J Vet Res* 2010; 71: 150–156.

80 Steagall PV, Aucoin M, Monteiro BP, et al. **Clinical effects of a constant rate infusion of remifentanil, alone or in combination with ketamine, in cats anesthetized with isoflurane.** *J Am Vet Med Assoc* 2015; 246: 976–981.

81 Gaumann DM, Yaksh TL, Tyce GM, et al. **Sympathetic stimulating effects of sufentanil in the cat are mediated centrally.** *Neurosci Lett* 1988; 91: 30–35.

82 Giordano T, Steagall PV, Ferreira TH, et al. **Postoperative analgesic effects of intravenous, intramuscular, subcutaneous or oral transmucosal buprenorphine administered to cats undergoing ovariohysterectomy.** *Vet Anaesth Analg* 2010; 37: 357–366.

83 Steagall PV, Pelligand L, Giordano T, et al. **Pharmacokinetic and pharmacodynamic modelling of intravenous, intramuscular and subcutaneous buprenorphine in conscious cats.** *Vet Anaesth Analg* 2013; 40: 83–95.

84 Robertson SA, Wegner K and Lascelles BDX. **Antinociceptive and side-effects of hydromorphone after subcutaneous administration in cats.** *J Feline Med Surg* 2009; 11: 76–81.

85 Doodnaught GM, Monteiro BP, Benito J, et al. **Pharmacokinetic and pharmacodynamic modelling after subcutaneous, intravenous and buccal administration of a high-concentration formulation of buprenorphine in conscious cats.** *PLoS One* 2017; 12: e0176443. DOI: 10.1371/journal.pone.0176443.

86 Wegner K, Robertson SA, Kollias-Baker C, et al. **Pharmacokinetic and pharmacodynamic evaluation of intravenous hydromorphone in cats.** *J Vet Pharmacol Ther* 2004; 27: 329–336.

87 Wegner K and Robertson SA. **Dose-related thermal antinociceptive effects of intravenous hydromorphone in cats.** *Vet Anaesth Analg* 2007; 34: 132–138.

88 Simon BT, Scallan EM, Monteiro BP, et al. **The effects of aging on hydromorphone-induced thermal antinociception in healthy female cats.** *Pain* 2019; 4: e722. DOI: 10.1097/PR9.0000000000000722.

89 Simon BT and Steagall PV. **The present and future of opioid analgesics in small animal practice.** *J Vet Pharmacol Ther* 2017; 40: 315–326.

90 Gurney M, Cripps P and Mosing M. **Subcutaneous pre-anaesthetic medication with acepromazine-buprenorphine is effective as and less painful than the intramuscular route.** *J Small Anim Pract* 2009; 50: 474–477.

91 Hofmeister EH and Egger CM. **Transdermal fentanyl patches in small animals.** *J Am Anim Hosp Assoc* 2004; 40: 468–478.

92 Davidson CD, Pettifer GR and Henry JD. **Plasma fentanyl concentrations and analgesic effects during full or partial exposure to transdermal fentanyl patches in cats.** *J Am Vet Med Assoc* 2004; 224: 700–705.

93 Murrell JC, Robertson SA, Taylor PM, et al. **Use of a transdermal matrix patch of buprenorphine in cats: preliminary pharmacokinetic and pharmacodynamic data.** *Vet Rec* 2007; 160: 578–583.

94 Duke-Novakovski T, Clark CR, Ambros B, et al. **Plasma concentrations of buprenorphine after epidural administration in conscious cats.** *Res Vet Sci* 2011; 90: 480–483.

95 DeRossi R, Hermeto LC, Jardim PHA, et al. **Postoperative pain control in cats: clinical trials with pre-emptive lidocaine epidural co-administered with morphine or methadone.** *J Feline Med Surg* 2016; 18: 882–888.

96 Troncy E, Junot S, Keroack S, et al. **Results of preemptive epidural administration of morphine with or without bupivacaine in dogs and cats undergoing surgery: 265 cases (1997–1999).** *J Am Vet Med Assoc* 2002; 221: 666–672.

97 Ambros B, Steagall PV, Mantovani F, et al. **Antinociceptive effects of epidural administration of hydromorphone in conscious cats.** *Am J Vet Res* 2009; 70: 1187–1192.

98 Steagall PV, Milette V, Mantovani FB, et al. **Antinociceptive effects of epidural buprenorphine or medetomidine, or the combination, in conscious cats.** *J Vet Pharmacol Ther* 2009; 32: 477–484.

99 Pypendop BH, Siao KT, Pascoe PJ, et al. **Effects of epidurally administered morphine or buprenorphine on the thermal threshold in cats.** *Am J Vet Res* 2008; 69: 983–987.

100 Herperger LJ. **Postoperative urinary retention in a dog following morphine with bupivacaine epidural analgesia.** *Can Vet J* 1998; 39: 650–652.

101 Scallan EM and Simon BT. **The effects of acupuncture point Pericardium 6 on hydromorphone-induced nausea and vomiting in healthy dogs.** *Vet Anaesth Analg* 2016; 43: 495–501.

102 Martin-Flores M, Mastrocco A, Lorenzutti AM, et al. **Maropitant administered orally 2–2.5 h prior to morphine and dexmedetomidine reduces the incidence of emesis in cats.** *J Feline Med Surg* 2017; 19: 876–879.

103 Martin-Flores M, Sakai DM, Learn MM, et al. **Effects of maropitant in cats receiving dexmedetomidine and morphine.** *J Am Vet Med Assoc* 2016; 248: 1257–1261.

104 Martin-Flores M, Sakai DM, Mastrocco A, et al. **Evaluation of oral**

maropitant as an antiemetic in cats receiving morphine and dexmedetomidine. *J Feline Med Surg* 2016; 18: 921–924.
105 Kenward H, Elliott J, Lee T, et al. **Anti-nausea effects and pharmacokinetics of ondansetron, maropitant and metoclopramide in a low-dose cisplatin model of nausea and vomiting in the dog: a blinded crossover study.** *BMC Vet Res* 2017; 13: 244. DOI: 10.1186/s12917-017-1156-7.
106 Robertson SA. **Managing pain in feline patients.** *Vet Clin North Am Small Anim Pract* 2008; 38: 1267–1290.
107 Ingwersen W, Fox R, Cunningham G, et al. **Efficacy and safety of 3 versus 5 days of meloxicam as an analgesic for feline onychectomy and sterilization.** *Can Vet J* 2012; 53: 257–264.
108 Speranza C, Schmid V, Giraudel JM, et al. **Robenacoxib versus meloxicam for the control of peri-operative pain and inflammation associated with orthopaedic surgery in cats: a randomised clinical trial.** *BMC Vet Res* 2015; 11: 79. DOI: 10.1186/s12917-015-0391-z.
109 King S, Roberts ES and King JN. **Evaluation of injectable robenacoxib for the treatment of post-operative pain in cats: results of a randomized, masked, placebo-controlled clinical trial.** *BMC Vet Res* 2016; 12: 215. DOI: 10.1186/s12917-016-0827-0.
110 Sattasathuchana P, Phuwapattanachart P and Thengchaisri N. **Comparison of post-operative analgesic efficacy of tolfenamic acid and robenacoxib in ovariohysterectomized cats.** *J Vet Med Sci* 2018; 80: 989–996.
111 Slingsby LS and Waterman-Pearson AE. **Postoperative analgesia in the cat after ovariohysterectomy by use of carprofen, ketoprofen, meloxicam or tolfenamic acid.** *J Small Anim Pract* 2000; 41: 447–450.
112 Sano T, King JN, Seewald W, et al. **Comparison of oral robenacoxib and ketoprofen for the treatment of acute pain and inflammation associated with musculoskeletal disorders in cats: a randomised clinical trial.** *Vet J* 2012; 193: 397–403.
113 Morton CM, Grant D, Johnston L, et al. **Clinical evaluation of meloxicam versus ketoprofen in cats suffering from painful acute locomotor disorders.** *J Feline Med Surg* 2011; 13: 237–243.
114 Kongara K and Chambers P. **Robenacoxib in the treatment of pain in cats and dogs: safety, efficacy, and place in therapy.** *Vet Med (Auckl)* 2018; 9: 53–61. DOI: 10.2147/vmrr.s170893.
115 Sparkes AH, Heiene R, Lascelles BDX, et al. **ISFM and AAFP consensus guidelines: long-term use of NSAIDs in cats.** *J Feline Med Surg* 2010; 12: 521–538.
116 Monteiro B and Steagall PV. **Antiinflammatory drugs.** *Vet Clin North Am Small Anim Pract* 2019; 49: 993–1011.
117 Giraudel JM, Gruet P, Alexander DG, et al. **Evaluation of orally administered robenacoxib versus ketoprofen for treatment of acute pain and inflammation associated with musculoskeletal disorders in cats.** *Am J Vet Res* 2010; 71: 710–719.
118 Grubb T and Lobprise H. **Local and regional anaesthesia in dogs and cats: overview of concepts and drugs (part 1).** *Vet Med Sci* 2020; 6: 209–217.
119 Vicente D and Bergström A. **Evaluation of intraoperative analgesia provided by incisional lidocaine and bupivacaine in cats undergoing ovariohysterectomy.** *J Feline Med Surg* 2018; 20: 922–927.
120 Moldal ER, Eriksen T, Kirpensteijn J, et al. **Intratesticular and subcutaneous lidocaine alters the intraoperative haemodynamic responses and heart rate variability in male cats undergoing castration.** *Vet Anaesth Analg* 2013; 40: 63–73.
121 Aguiar J, Chebroux A, Martinez-Taboada F, et al. **Analgesic effects of maxillary and inferior alveolar nerve blocks in cats undergoing dental extractions.** *J Feline Med Surg* 2015; 17: 110–116.
122 Zilberstein LF, Moens YP and Leterrier E. **The effect of local anaesthesia on anaesthetic requirements for feline ovariectomy.** *Vet J* 2008; 178: 214–218.
123 Robertson SA and Taylor PM. **Pain management in cats – past, present and future. Part 2. Treatment of pain – clinical pharmacology.** *J Feline Med Surg* 2004; 6: 321–333.
124 Gordon-Evans WJ, Suh HY and Guedes AG. **Controlled, non-inferiority trial of bupivacaine liposome injectable suspension.** *J Feline Med Surg* 2020; 22: 916–921.
125 Niemiec B, Gawor J, Nemec A, et al. **World Small Animal Veterinary Association global dental guidelines**. *J Small Anim Pract* 2020; 61. DOI: 10.1111/jsap.13132.
126 Oliveira RL, Soares JH, Moreira CM, et al. **The effects of lidocaine–prilocaine cream on responses to intravenous catheter placement in cats sedated with dexmedetomidine and either methadone or nalbuphine.** *Vet Anaesth Analg* 2019; 46: 492–495.
127 O'Brien TQ, Clark-Price SC, Evans EE, et al. **Infusion of a lipid emulsion to treat lidocaine intoxication in a cat.** *J Am Vet Med Assoc* 2010; 237: 1455–1458.
128 Maierl J and Liebich H-G. **Investigations on the postnatal development of the macroscopic proportions and the topographic anatomy of the feline spinal cord.** *Anat Histol Embryol* 1998; 27: 375–379.
129 Pratt CL, Balakrishnan A, McGowan E, et al. **A prospective randomized, double-blinded clinical study evaluating the efficacy and safety of bupivacaine versus morphine–bupivacaine in caudal epidurals in cats with urethral obstruction.** *J Vet Emerg Crit Care* 2020; 30: 170–178.
130 O'Hearn AK and Wright BD. **Coccygeal epidural with local anesthetic for catheterization and pain management in the treatment of feline urethral obstruction.** *J Vet Emerg Crit Care* 2011; 21: 50–52.
131 Credie L and Luna S. **The use of ultrasound to evaluate sacrococcygeal epidural injections in cats.** *Can Vet J* 2018; 59: 143–146.
132 Fudge JM, Page B, Mackrell A, et al. **Evaluation of targeted bupivacaine for reducing acute postoperative pain in cats undergoing routine ovariohysterectomy.** *J Feline Med Surg* 2020; 22: 91–99.
133 Yilmaz ÖT, Toydemir TSF, Kirşan I, et al. **Effects of surgical wound infiltration with bupivacaine on postoperative analgesia in cats undergoing bilateral mastectomy.** *J Vet Med Sci* 2014; 76: 1595–1601.
134 Crisi PE, De Santis F, Giordano MV, et al. **Evaluation of eutectic lidocaine/prilocaine cream for jugular blood sampling in cats.** *J Feline Med Surg* 2021; 23: 185–189.
135 Wagner KA, Gibbon KJ, Strom TL, et al. **Adverse effects of EMLA (lidocaine/prilocaine) cream and efficacy for the placement of jugular catheters in hospitalized cats.** *J Feline Med Surg* 2006; 8: 141–144.
136 Gibbon KJ, Cyborski JM, Guzinski MV, et al. **Evaluation of adverse effects of EMLA (lidocaine/prilocaine) cream for the placement of jugular catheters in healthy cats.** *J Vet Pharmacol Ther* 2003; 26: 439–441.
137 Steagall PV, Benito J, Monteiro B, et al. **Intraperitoneal and incisional analgesia in small animals: simple, cost-effective techniques.** *J Small Anim Pract* 2020; 61: 19–23.
138 Benito J, Monteiro B, Lavoie AM, et al. **Analgesic efficacy of intraperitoneal administration of bupivacaine in cats.** *J Feline Med Surg* 2016; 18: 906–912.
139 Benito J, Evangelista MC, Doodnaught GM, et al. **Analgesic efficacy of bupivacaine or bupivacaine-dexmedetomidine after intraperitoneal administration in cats: a randomized, blinded, clinical trial.** *Front Vet Sci* 2019; 6: 307. DOI: 10.3389/ fvets.2019.00307.
140 Benito J, Monteiro BP, Beaudry F, et al. **Pharmacokinetics of bupivacaine after intraperitoneal administration to cats undergoing ovariohysterectomy.** *Am J Vet Res* 2016; 77: 641–645.

141 Benito J, Monteiro B, Beaudry F, et al. **Efficacy and pharmacokinetics of bupivacaine with epinephrine or dexmedetomidine after intraperitoneal administration in cats undergoing ovariohysterectomy.** *Can J Vet Res* 2018; 82: 124–130.

142 De OL Carapeba G, Nicácio IPGA, Stelle ABF, et al. **Comparison of perioperative analgesia using the infiltration of the surgical site with ropivacaine alone and in combination with meloxicam in cats undergoing ovariohysterectomy.** *BMC Vet Res* 2020; 16: 88. DOI: 10.1186/s12917-020-02303-9.

143 Nicácio IP, Stelle ABF, Bruno TS, et al. **Comparison of intraperitoneal ropivacaine and ropivacaine–dexmedetomidine for postoperative analgesia in cats undergoing ovariohysterectomy.** *Vet Anaesth Analg* 2020; 47: 396–404.

144 Soltaninejad H and Vesal N. **Plasma concentrations of lidocaine following laryngeal administration or laryngeal and intratesticular administration in cats.** *Am J Vet Res* 2018; 79: 614–620.

145 Fernandez-Parra R, Zilberstein L, Fontaine C, et al. **Comparison of intratesticular lidocaine, sacrococcygeal epidural lidocaine and intravenous methadone in cats undergoing castration: a prospective, randomized, investigator-blind clinical trial.** *Vet Anaesth Analg* 2017; 44: 356–363.

146 Watanabe R, Doodnaught G, Proulx C, et al. **A multidisciplinary study of pain in cats undergoing dental extractions: a prospective, blinded, clinical trial.** *PLoS One* 2019; 14: e0213195. DOI: 10.1371/journal.pone.0213195.

147 Rochette J. **Regional anesthesia and analgesia for oral and dental procedures.** *Vet Clin North Am Small Anim Pract* 2005; 35: 1041–1058.

148 Gross ME, Pope ER, Jarboe JM, et al. **Regional anesthesia of the infraorbital and inferior alveolar nerves during noninvasive tooth pulp stimulation in halothane-anesthetized cats.** *Am J Vet Res* 2000; 61: 1245–1247.

149 Grubb T and Lobprise H. **Local and regional anaesthesia in dogs and cats: descriptions of specific local and regional techniques (part 2).** *Vet Med Sci* 2020; 6: 218–234.

150 Perry R, Moore D and Scurrell E. **Globe penetration in a cat following maxillary nerve block for dental surgery.** *J Feline Med Surg* 2015; 17: 66–72.

151 Volk H, Bayley K, Fiani N, et al. **Ophthalmic complications following ocular penetration during routine dentistry in 13 cats.** *N Z Vet J* 2019; 67: 46–51.

152 Aprea F, Vettorato E and Corletto F. **Severe cardiovascular depression in a cat following a mandibular nerve block with bupivacaine.** *Vet Anaesth Analg* 2011; 38: 614–618.

153 Simon BT and Steagall PV. **Feline procedural sedation and analgesia: when, why and how.** *J Feline Med Surg* 2020; 22: 1029–1045.

154 Pereira MA, Campos KD, Gonçalves LA, et al. **Cyclooxygenases 1 and 2 inhibition and analgesic efficacy of dipyrone at different doses or meloxicam in cats after ovariohysterectomy.** *Vet Anaesth Analg* 2021; 48: 7–16.

155 Chandrasekharan NV, Dai H, Roos KLT, et al. **COX-3, a cyclooxygenase-1 variant inhibited by acetaminophen and other analgesic/antipyretic drugs: cloning, structure, and expression.** *Proc Natl Acad Sci* 2002; 99: 13926139-31. DOI: 10.1073/ pnas.162468699.

156 Jasiecka A, Maślanka T and Jaroszewski JJ. **Pharmacological characteristics of metamizole.** *Pol J Vet Sci* 2014; 17: 207–214.

157 Zanuzzo FS, Teixeira-Neto FJ, Teixeira LR, et al. **Analgesic and antihyperalgesic effects of dipyrone, meloxicam or a dipyrone–meloxicam combination in bitches undergoing ovariohysterectomy.** *Vet J* 2015; 205: 33–37.

158 Teixeira LG, Martins LR, Schimites PI, et al. **Evaluation of postoperative pain and toxicological aspects of the use of dipyrone and tramadol in cats.** *J Feline Med Surg* 2020; 22: 467–475.

159 Lebkowska-Wieruszewska B, Kim TW, Chea B, et al. **Pharmacokinetic profiles of the two major active metabolites of metamizole (dipyrone) in cats following three different routes of administration.** *J Vet Pharmacol Ther* 2018; 41: 334–339.

160 Cheng J-K and Chiou L-C. **Mechanisms of the antinociceptive action of gabapentin.** *J Pharmacol Sci* 2006; 100: 471–486.

161 Adrian D, Papich MG, Baynes R, et al. **The pharmacokinetics of gabapentin in cats.** *J Vet Intern Med* 2018; 32: 1996–2002.

162 Siao KT, Pypendop BH and Ilkiw JE. **Pharmacokinetics of gabapentin in cats.** *Am J Vet Res* 2010; 71: 817–821.

163 Slovak JE and Costa AP. **A pilot study of transdermal gabapentin in cats.** *J Vet Intern Med* 2021; 35: 1981–1987.

164 Vettorato E and Corletto F. **Gabapentin as part of multi-modal analgesia in two cats suffering multiple injuries.** *Vet Anaesth Analg* 2011; 38: 518–520.

165 Pankratz KE, Ferris KK, Griffith EH, et al. **Use of single-dose oral gabapentin to attenuate fear responses in cage-trap confined community cats: a double-blind, placebo-controlled field trial.** *J Feline Med Surg* 2018; 20: 535–543.

166 Pozzi A, Muir WW and Traverso F. **Prevention of central sensitization and pain by N-methyl-D-aspartate receptor antagonists.** *J Am Vet Med Assoc* 2006; 228: 53–60.

167 Brondani JT, Luna LSP, Beier SL, et al. **Analgesic efficacy of perioperative use of vedaprofen, tramadol or their combination in cats undergoing ovariohysterectomy.** *J Feline Med Surg* 2009; 11: 420–429.

168 Steagall PV, Taylor PM, Brondani JT, et al. **Antinociceptive effects of tramadol and acepromazine in cats.** *J Feline Med Surg* 2008; 10: 24–31.

169 Pypendop BH and Ilkiw JE. **Pharmacokinetics of tramadol, and its metabolite O-desmethyl-tramadol, in cats.** *J Vet Pharmacol Ther* 2008; 31: 52–59.

170 Indrawirawan Y and McAlees T. **Tramadol toxicity in a cat: case report and literature review of serotonin syndrome.** *J Feline Med Surg* 2014; 16: 572–578.

171 Steagall PV, Pelligand L, Page SW, et al; WSAVA Therapeutic Guidelines Group (TGG). **The World Small Animal Veterinary Association (WSAVA): list of essencial medicines for cats and dogs.** *J Small Anim Pract* 2020; 16; 61. DOI: 10.1111/jsap.13135.

172 Beloeil H. **Opioid-free anesthesia.** *Best Pract Res Clin Anaesthesiol* 2019; 33: 353–360.

173 Chia PA, Cannesson M and Bui CCM. **Opioid free anesthesia: feasible?** *Curr Opin Anaesthesiol* 2020; 33: 512–517.

174 Forget P. **Opioid-free anaesthesia. Why and how? A contextual analysis.** *Anaesth Crit Care Pain Med* 2019; 38: 169–172.

175 Diep TN, Monteiro BP, Evangelista MC, et al. **Anesthetic and analgesic effects of an opioid-free, injectable protocol in cats undergoing ovariohysterectomy: a prospective, blinded, randomized clinical trial.** *Can Vet J* 2020; 61: 621–628.

Appendix: Cat Carer Guide

ACUTE PAIN

Recognising and managing acute pain in cats: information for owners/caregivers

If your cat is undergoing surgery, has suffered an accident or has an underlying illness causing pain, it is important for you to recognise the signs of discomfort and know how you and your veterinarian will work together to manage your cat's pain.

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DOI: 10.1177/1098612X211066268